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Residential Energy Information Systems:

A Technology Acceptance Approach

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Abstract:

Technology and information systems has been instrumental in supporting multiple industries for the past 3 decades. The rapid growth of information and communication technology has led to better understanding to utilize these techs in solving many existing environmental issues. One of these issues is the residential energy consumption which accounts for more than 30% of the total energy consumption around the world as per the Iea (2014). This paper, is an empirical research on the acceptance and usability of residential energy information systems. The paper studies the impact of personal characterises, social factors, perceived usefulness, perceived ease of use, perceived risks & benefits on the attitude towards using a Residential Energy Information Systems.

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Chapter 1. Introduction

Domestic energy consumption was defined by Lee Schipper as the structure and intensity of energy use is domestic entities (Schipper, 2013). While households and residential building consumption accounts for more than 33.3% of the world's total primary energy (Iea, 2014) it is vital to consider energy efficiency improvements. In order to improve energy efficiency, it is important to manage the energy consumption and gather energy consumption data, which can be done through the implementation of smart grids (Palma-Behnke R. et al., 2013). Smart grids are communication and information networks integrated within the electrical power grid (Jarrah et al., 2015). A smart grid is a technological solution for electric power system management (Palma-Behnke et al., 2013) in which it provides reliability, efficiency, reduced power loss, distributed power demands over time to vanish peak hours, low billing process, automated monitoring and control for effective power management and energy restoration (Jarrah et al., 2015).

The integration of new information technology solutions within the energy sector, lead to the utilization of energy consumption data and information processing, through data extracting, transferring, loading, visualizing and analysing energy data through what is known as Energy Information Systems (EIS) (Capehart and Capehart, 2005). An EIS can help energy consumers understand and manage the energy through an consumption display (Wood and Newborough, 2007). This display acts like an informative interface to inform the users on their energy consumption patterns. Energy informative displays are believed to motivate consumers to live in a more energy efficient rise the consumer's awareness on energy consumption habits (Wood and Newborough, 2007). An efficient and low energy consumption house is considered a house that only consumes about 50% of the energy that is approved in accordance to current building norms (Fastigheter, 2013b).

For Information Systems solutions to succeed, it is essential that the technology is accepted and trusted by the end users, in which most information systems fail due to low user acceptance rather than quality issues (Torkzadeh and Angulo, 1992). To predict, explain, and increase user acceptance, there is an essential need to understand why people accept or reject technological solutions (Fred D. Davis et al., 1989). Several theoretical models have been generated and used in order to measure information systems user acceptance such as the Technology Acceptance Model (TAM) by (Davis, 1985) and the Unified Theory of Acceptance and Use of Technology (UTAUT) by (Venkatesh et al., 2003). Such models are often utilized as the theoretical foundation to classify the various factors influencing users' intentions and use of information technology solutions.

1.1 Background

As per Ueno et al. (2006) an energy consumption information system major role is motivating energy-saving activities within households. Ueno et al. (2006) reported significant findings studying the effectiveness of residential energy information systems , in which the energy saving activities were successfully encouraged by the system and the total power consumption decreased by an average of 18% (Ueno et al., 2006). Knowing that residential building consumption accounts for more than 33.3% of the world's total primary energy (Iea, 2014).

Ueno et al. (2006) did utilize the information system domain by implementing the energy consumption information system within 10 households and calculating the total energy consumption before and after the IS implementation. Moreover, Yew et al. (2012) conducted a theoretical research to prompt efficient energy consumption behaviour within residents. In Figure 1.1 below, the framework concentrates on the process of reducing energy consumption through information systems. That said, although both studies had close goals, however the output data was used to only analyse the change in energy demand and energy consumption behaviour, while there is a great opportunity to also study the Technology Acceptance side of Energy Information Systems. Currently, energy sustainability is becoming a very important

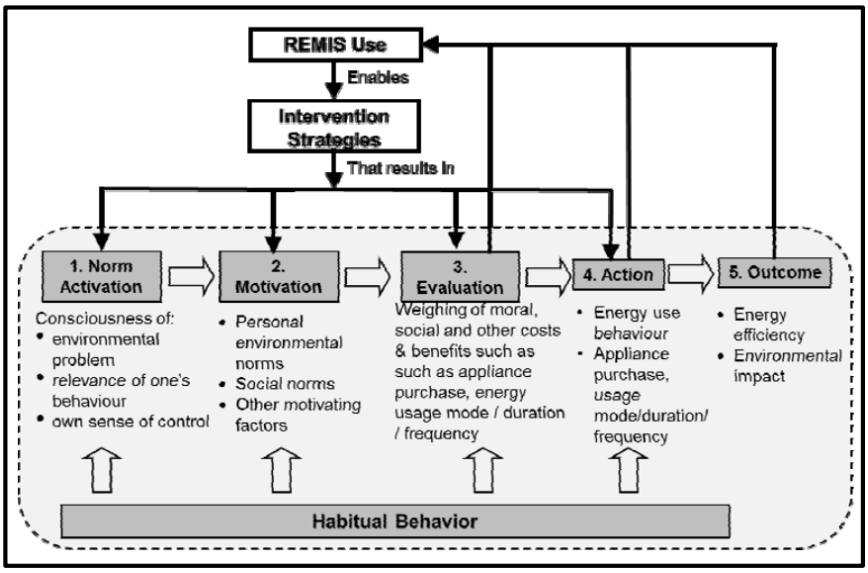

Figure 1.1 Residential energy management IS framework (Yew et al., 2012)

consideration, and with the current advanced information and communication technologies, sustainability, and information security we believe that technology acceptance has become a vital step towards ensuring the success of a new solution,

Similar to any other new and advanced technology solution, for an EIS to be utilized at its full potential and have a significant contribution to reducing energy consumption, it is important for the system to be accepted by the users (Torkzadeh and Angulo, 1992) & (Fred D. Davis et al., 1989). This is why there is a need to better understand why people resist using a system, predict how users will respond to it, and improving user acceptance by altering the nature of the system and the process by which it is implemented (Fred D. Davis et al., 1989). The Technology Acceptance Model (TAM), which was introduced by (Davis, 1985), is a model which suggests that there are a number of factors that influence the user's decision about how and when they will use it (Fred D. Davis et al., 1989). There are two major factors which look at the user's attitude towards the system, Perceived Usefulness (PU) and Perceived Ease-Of-Use (PEOU). PU is to which degree of which the user believes that the system will enhance the user's performance (Fred D. Davis et al., 1989), or in the case of an EIS, to which degree the system will useful to help users save energy, save money and be more environmental friendly.

PEOU is to which degree the user believes that the system would be easy to use and free from effort (Fred D. Davis et al., 1989).

1.2 Problem Area

In the last decade, organizations across the world have recognized sustainability as a major strategic goal (Siegel, 2009). At the same time the rapid growth of information and communication technology in the last two decades and the human contribution in promoting environmental sustainability is significant (Watson et al., 2010). One of the major factors that contributes to Information Systems' success is the user technology acceptance (Fred D. Davis et al., 1989). Although, countless research has been done on several types of information systems, however less research was conducted on particularly studying the technology acceptance of energy information systems (EIS). The fact that there are systems are not utilized to their full potential simply because the technology isn't accepted by the users or the system is not being used as intended to (Venkatesh et al., 2003). Usefulness is considered a very important factor that affects the user's decision on implementing the solution in the first place (Fred D. Davis et al., 1989). This shows that there is a need to gain deeper understanding on how the everyday users can perceive an EIS and to what extent they would accept this technology. Nevertheless, cultural differences influence individuals values towards things and affect their behaviour (Hofstede, 1980). Which means that the PU and the PEOU in the Technology Acceptance Model are subject to affection by cultural factors and therefore culture has a basic impact on the intention of the user to adopt change.

Based on table 1.1, the majority of research on technology acceptance focuses on general practices of information systems but minimal research has been done on residential users accepting EIS. Which is why this thesis will conduct an empirical study with potential EIS users in residential households, as well as a company that implements residential EIS.

1.3 Motivation

After reading about sustainability, residential consumption, EIS, technology acceptance, and how culture plays a role in users values and behaviour (see table 1.1) Our preliminary understanding is that there is still enough room for studying the technology acceptance of energy information systems within residents coming from different cultures. If user and technology acceptance is understood and there is a plan to manage the user acceptance, the system will be more successful, which leads to less energy usage. Since only about 11% of all new residential buildings in Sweden are low-energy buildings (Fastigheter, 2013b) there is room to gain a deeper understanding in how they work and how EIS can help in the making a what is known as sustainable residents.

1.4 Research Question

Our research will be focusing on technology acceptance and the TAM, specifically on EIS and the difference between two countries, Sweden and Germany.

The research question is a ”Do/Does” question, which means that we have explored and described a topic where an unclear knowledge exists (Recker, 2013), and will be as follows:

Do Swedish and German residents accept the use of residential energy information systems?

When new technologies are implemented there are multiple factors that affect users’ technology acceptance (Venkatesh et al., 2003). In our research we will focus on age, nationality and location factors (Fred D. Davis et al., 1989) by focusing on the age group 18-65 and the two nationalities Swedish and German. The nationalities were chosen since they have two different cultures when it comes to sustainable technology acceptance where 2014 statistics have shown that Sweden ranks 4th while Germany ranks 6th in accessibility of open data that had a noticeable impact on environmental sustainability (Index, 2014). Finally, our research will also be restricted to EIS within residential sector.

Chapter 2. Literature Review and Basic Definitions

Theme	Sub-areas	Literature
Information Systems	Definition and History	(Mingers and Stowell, 1997); (Hirschheim and Heinz, 2010); (Davis and Olson, 1985); (Land, 1985); (Laudon and Laudon, 2015)
Energy Information System (EIS)	Residential Energy Information System (REIS) Residential Energy Data and Informatics Residential Energy Consumption Behaviour • Human Factor • Physical Factor	(Capehart and Capehart, 2005); (Watson et al., 2010); (Granderson, 2013); (Jessica Granderson et al., 2013); (Tsuji et al., 2000); (Wood and Newborough, 2003); (Gil Allouche, 2016); (De Mauro et al., 2015) ; (Mayer-Schönberger and Cukier, 2013); (Davenport, 2006); (Zikopoulos et al., 2012); (De Mauro et al., 2015); (Boyd and Crawford, 2012); (Keller and Preece, 1990); (Hitchcock, 1993)
IS and Residential Energy Sustainability	Energy Metrics and Sustainability Individual and Organizational Sustainability	(Brundtland, 1985); (Closs et al., 2011); (Wunderlich, 2013); (Jenkin et al., 2011).; (Setterstrom, 2008); (Melville, 2010); (Manning, 2007).; (Grubb et al., 2009); (McNamara and Grubb, 2011); (Stern, 2000); (Baddeley, 2011); (Reynolds et al., 2010); (Pongiglione, 2011)
Technology Acceptance	User Acceptance Technology Acceptance Model (TAM)	(Davis, 1989); (Davis, 1985)
Information Security	Residential Energy Information Security and Sensitivity ➢ Energy Data use ➢ Information Privacy	(Bélanger and Crossler, 2011); (Westin, 2003); (Clarke, 1999); (Westin, 2003); (Agre and Rotenberg, 1998); (Derlega and Chaikin, 1977); (Thelwall and Stuart, 2006) & (Culnan and Bies, 2003); (Caudill and Murphy, 2000); (Escudero-Pascual and Hosein, 2004); (Bloom et al., 1994, Norberg et al., 2007); (Sayre and Horne, 2000); (Mason and Culnan, 1995) (Nowak and Phelps, 1992)

Table 2.1 Literature Framework.

2.1 Information systems

An Information System was primary introduced back in the 1960s and was referred to as "Management Information Systems". It was originally composed from computer science, management, organizational theory, operations research, and accounting (Davis and Olson, 1985).

The first widely recognized historical handling of Management Information Systems field was published by Gary Dickson in 1981 (Mingers and Stowell, 1997). Over the years, information systems witnessed too many directional shifts, in which the core definition evolved through several waves. Most of these waves originated particularly in Scandinavia, and the United States. (Hirschheim and Heinz, 2010)

But it was until the 1985 in which Information system was basically defined by (Land, 1985) as a social system in which significant sides of information technology are combined without treating it as a social system (Land, 1985). However, as the era of digital information evolved rapidly during the last three decades, the definition of Information systems has been simplified and clarified by IS scholars. That said, our research we will refer to information systems as defined by (Laudon and Laudon, 2015). Information systems are a combination of interrelated social and physical components cooperating to collect, process, store, and publish information in order to support decision making, coordination, control, analysis, and visualization (Laudon and Laudon, 2015).

Information systems have become an essential part of our daily routine. In any given modern community, there are multiple integrated information systems that are embedded into different business and environmental sectors. And due to the nature of our research, this study is using the Energy Information Systems and particularly Residential EIS which we will define later in this section.

2.2 Residential Energy Sector

Electricity is the world's fastest growing form of end-use energy consumption, where the residential sector consumes more than 14 percent of the total energy supply (I.M.F.I.E., 2012) Due to the continued economic growth, countries are experiencing a significant increase in demand for energy, in which it's expected to witness 61 percent increase in energy production by 2040 (I.M.F.I.E., 2012). Thus, energy systems have continued to evolve from isolated small grids to integrated national markets and even international markets. (I.M.F.I.E., 2012)

The residential sector energy demand is currently growing by 1.1 percent each year as per (I.M.F.I.E., 2012). This demand growth is forcing energy providing companies to use multiple sources of energy production to fill in the demand gap in which not all are considered to be environmentally friendly. However sustainable energy production sources are on the rise for the past decade, and the awareness on using renewable energy sources is increasing, where the world relied on sustainable energy sources for around 22 percent of its total primary energy supply in 2015 and expected of reaching at least 26% increase by 2020 (I.M.F.I.E., 2012).

In this section, there are three extents of the residential energy sector that we will focus on: (1) Residential Energy Information Systems (REIS), Residential energy consumption and (3) Energy Informatics.

2.2.1 Residential Energy Information Systems (REIS)

Theoretically, Energy systems were traditionally defined as management subsystems used in buildings, industries and communities through combined energy management and control functions (Capehart and Capehart, 2005). However, this definition has evolved after the rapid growth of digital information. The need for information processing, which includes data extracting, transferring, loading, visualizing and analysing, have led to a new term known as Energy Information Systems (Capehart and Capehart, 2005).

On another definition, Watson et al. (2010) listed the major functions of energy information systems that are tied together to provide a complete solution in which an EIS perform the following:

- Data Collection from the sensor network installed in a household
- Transmit collected data to automated controllers in the flow network
- Supply information to flow network managers
- Feed information to consumers about the consumption of resources within their control
- Manage supply and demand to minimize energy consumption
- Enable consumers to automate or control object usage to prompt energy efficiency
- feed comparative information to vendors and consumers
- Supply information to authorities (Watson et al., 2010).

Practically, Energy Information Systems are mostly defined as the composite of (1) software, (2) data acquisition hardware, and (3) Information systems used to store, analyse, and display energy informatics. EIS usually comprise analysis methods such as tracking, benchmarking, monitoring, interacting, baselining, and reporting (Granderson, 2013).

A Residential Energy Information Systems (REIS), is actually an EIS, which is implemented in households and residential units. This energy solution has been evolving rapidly in the latest years in which many leading companies have introduced smart energy solutions. As an example, we will mention 4 of the most recent solutions introduced in Europe and North America.

1. Energy Management and Smart Utilities, introduced by CGI and tested in Sweden. This program is a massive solution in which Residential EIS is a part of. (C. G. I., 2013)
2. Schnieder's Enterprise Energy Management Information System (EMIS), introduced by Schneider Electric in Germany and France. This solution claims to promote energy consumption behavioural change, raise awareness, and identify saving opportunities. (Electric, 2009)

3. Energy information system (EIS), Introduced by the Lawrence Berkeley National Laboratory and sponsored by the US department of energy, in which they claim it enables savings, rather than directly generating savings. (Jessica Granderson et al., 2013)
4. Canadian Energy Management Information Systems (EMIS), Introduced by the Canadian Government, Natural Resources department. They claim that this solution prompt energy efficiency at residential and commercial buildings. (National Resources Canada, 2016)

EISs, are solutions that deal with a specific type of data. This data is often referred to as Energy Data & Informatics (Watson et al., 2010). And since our study is oriented on Residential EISs, thus we are going to briefly define and elaborate on this subject in the following section.

2.2.2 Residential Energy Data & Informatics

Richard T. Watson states that to understand Energy Informatics concept it is important to first comprehend the foundation in which the concept is based on: Energy + Information < Energy. In other words, if enough energy informatics is acquired, it is believed that will lead to a successful decrease in energy demand as clarified in figure 2.1 (Watson et al., 2010)

Our Area of Research, will focus in the Consumption side as shown in figure 2.1. The Consumption factors will be defined later in this literature review.

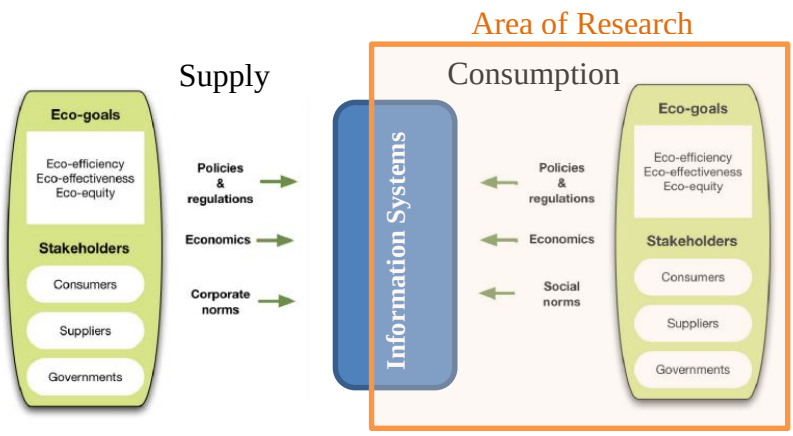

Figure 2.1 Energy Informatics articulated from figure 1. Framework (Watson et al., 2010)

Energy Informatics are processed by Energy Information Systems and categorized into:

1. Input: Energy consumption data, which is the raw energy consumption data collected from residential units
2. Rules: Factors that may influence energy consumption, such as regulations, social norms, and financial factors
3. Output: Energy performance Informatics, or in other words reports articulated based on the energy data collected (Watson et al., 2010).

As per (Watson et al., 2010), the key activity questions that should be asked when dealing with energy informatics are : How will data be collected? How will data be analysed? And Who is empowered to make changes related to energy efficiency?

However, based on the nature of our study, we will have to take a slightly different approach, in which we will have to mention What data will be collected, what data will be in use? and Who is empowered to use this data? Based on the outcome of these questions, we will later articulate our interview questionnaire.

The Residential EIS connects together all the different components, providing a complete solution to monitor the household energy consumption through:

- Collection of data from the sensors devices network
- Transfer data to automated controllers and data storage units
- Structure and analyse the energy data
- Feed energy reports' information to energy corporates, governments and sometimes to third party vendors.
- Feed energy consumption information to end users
- Control energy supply and demand to prompt energy efficiency
- Allow end users to automatically control devices usage to reduce energy consumption. (Watson et al., 2010)

Thus, the above set of steps will form an automatic feedback solution for vendors and energy providing companies, as well as control and monitoring options for the end users.

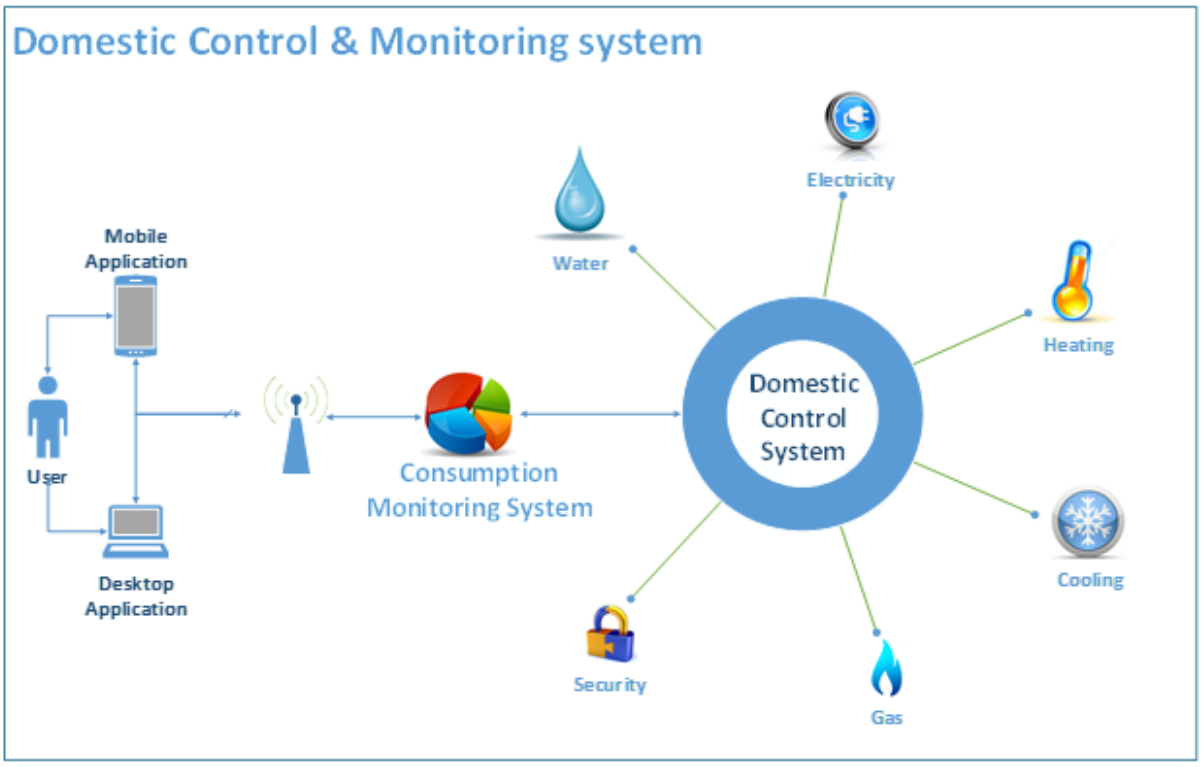

Figure 2.2 Energy Data articulated based Categorization of end-use purposes (Tsuji et al., 2000)

Tsuji et al. (2000) listed the major energy data that is often acquired by residential EIS. Figure 2 Demonstrates the basic data extracted, transferred and analysed by a typical Residential EIS. Any type of information has to be up to a specific standard of security depending on its sensitivity. Energy information is no different than any other collected data. Wood and Newborough (2003) classified the electricity components consumption at household as (1) predictable, (2) moderately predictable, and (3) un-predictable. Although this classification is the closet to reality, however it cannot detect why is energy consumption is different from one household to another (Wood and Newborough, 2003). However, with the use of an EIS on a large scale, will allow a better understanding of human energy consumption behaviour though big data analysis (Wood and Newborough, 2003).

Our current energy resources are not going to last long. Thus, many environmentalists are fighting towards an increase in using renewable energy and utilize the advanced information technology to prompt energy consumption efficiency.

2.2.2.1 Big Data and Energy Sector

Big Data is considered one major utility to better understand energy consumption behaviour and prompt energy efficiency. Bid Data implementation within the residential energy sector, is believed to drastically (1) prompt energy consumption efficiency at households, through advanced analytical and data processing technologies (Gil Allouche, 2016)

For the past decade, data management and analysis have evolved and Big Data started to have an increased attention within the information technology community (De Mauro et al., 2015). Numberless studies and researched were conducted in the last 10 years on defining and interpreting Big Data and studies are still ongoing, however there is still not a clear vision on how Big Data can affect communities, individuals and organizations (De Mauro et al., 2015) & (Mayer-Schönberger and Cukier, 2013). Despite the fact that Big Data is still at an early stage of development, but we can see that extracting real-time huge and complex data with advanced computing and analytical procedures has become a source of competition with in all industries (Davenport, 2006) and energy is one of them. Volume, velocity, and variety, are considered pillars of Bid Data (Zikopoulos et al., 2012)

Big Data is believed to make big difference in data analysis and reporting, but these advantages are often accompanied by noteworthy challenges (De Mauro et al., 2015). Boyd and Crawford (2012) mentioned that “very little is understood about the ethical implications underpinning the Big Data phenomenon” and Big Data is enabling incursions of personal and organizational privacy, decreasing civil freedoms, and increased state and corporate domination” (Boyd and Crawford, 2012).

As the majority of inhabited areas round the world are heavily relying on energy, and inhabitants continue to increase, we are witnessing significant increase in energy demand. Where at some parts of the world there is a gap between supply and demand. Improving energy consumption efficiency is believed to contribute heavily in diminishing this gap. By implementing advanced information technology changes to the energy sector, and using big data analytics, the energy sector can gain numerous advantages such as energy demand management, energy procurement, tariff-based savings, and energy costs reduction (Syed, 2015) & (Agency, 2015)

Energy efficiency have become one of the highest priorities for most organisations. And since energy consumption is considered a significant part of sustainability research, the leverage on Big Data, information technology and advanced energy information systems solutions will significantly help in optimising energy consumption, reducing energy cost and enabling better usage of energy infrastructure (Syed, 2015)

2.2.3 Residential Energy Consumption Behaviour

A better understanding of human and equipment interaction can promote to an effec-

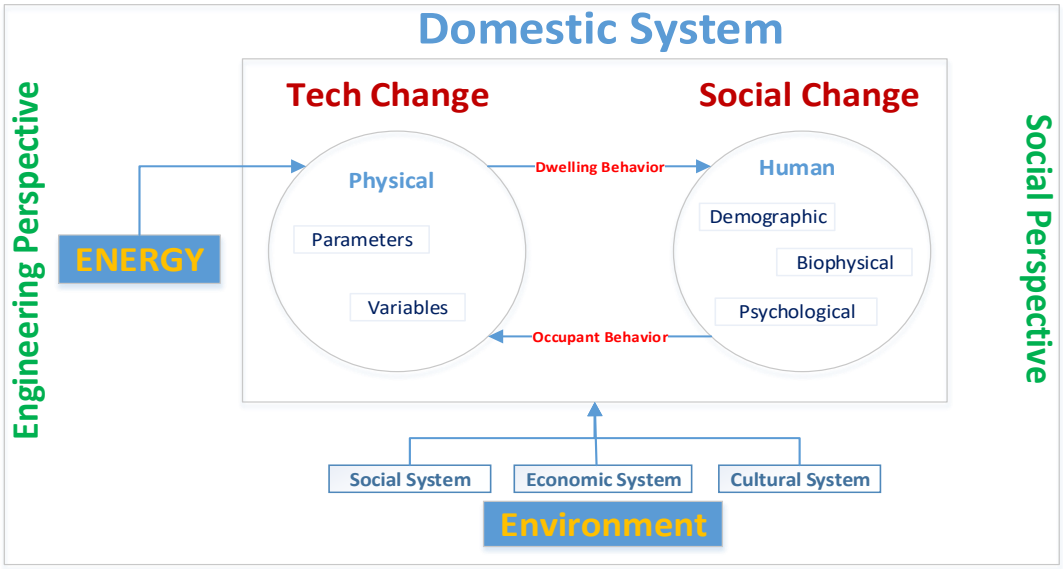

Figure 2.3 Articulated based on Fig 3. (Hitchcock, 1993) Subject categories applied to the domestic systems

tive energy efficient consumption behaviour (Wood and Newborough, 2003). Such an understanding can allow both end users and energy suppliers to work toward an effective energy consumption reduction steps through consumption behavioural change. The human factor and physical factors heavily influence the feedback process when studying the energy consumption process (Keller and Preece, 1990) One of the first interpretations on domestic energy systems and energy consumptions factors was introduced by (Hitchcock, 1993). Figure 2.3 demonstrates the human physical factors relation, and their interaction with the Environment and Energy.

2.2.3.1 Human Factor

The human factor, also referred to as “end user” in this research, is affected by the social change, where demographic, biophysical and psychological aspects control the human behaviour. Humans interact with physical devices with an occupant behaviour in which it’s always affected by environmental factors such as the cultural system, economic system and the social system. The relation of Humans and energy is not direct as per (Hitchcock, 1993), where the real interaction is with the physical object itself.

2.2.3.2 Physical factor

The physical factor, also referred to as “devices” or “appliances” in this research, is affected by the technology changes, in which parameters and variables aspects are controlled by the object technical norms. The physical Factor affects humans through a dwelling behaviour in which humans will get used to a specific behaviour towards a given energy consuming

object. Devices are also affected by the environmental factors depending on the social, economic and the cultural system (Hitchcock, 1993).

On the other hands, (Wood and Newborough, 2003) energy consumption feedback process demonstrates three major factors, in which end users interact with both Appliances and the Electronic systems, which is the Residential EIS in our case. The interaction between the human and the Residential EIS is dependent on the level of usability of the system and how much acceptance does the end user has to this technology. In the following section we will have a brief look at the Technology Acceptance definition and we will elaborate our discussion on the Technology Acceptance Model in Chapter 3 of this Research.

2.3 Technology Acceptance

Technology acceptance is a term based on a theoretical model developed by Davis (1985). The model name is Technology Acceptance Model referred to as “TAM” (Davis, 1985). The two major objectives of TAM are (1) “it should improve our understanding of user acceptance processes, providing new theoretical insights into the successful design and implementation of information systems” (Davis, 1985) and (2) “It should provide the theoretical basis for a practical "user acceptance testing" methodology that would enable system designers and implementers to evaluate proposed new systems prior to their implementation” (Davis, 1985). The model application is based on (1) “applying the proposed model in user acceptance testing would involve demonstrating system prototypes to potential users and measuring their motivation to use the alternative systems” (Davis, 1985) . The goal from the user acceptance testing is to gather useful information on the likelihood and acceptance of the solution proposed (Davis, 1985).

2.3.1 User Acceptance Testing

User Acceptance Testing which is referred to as “UAT”, “briefly demonstrates a set of alternative new systems to representatives of the intended user population in a laboratory setting […] and measuring their motivation to use the systems […] Based upon these measurements, the degree of likely acceptance of the system by the users would be predicted.” (Davis, 1985)

As per Davis (1985), for the user acceptance testing to be practical, all the associated motivational model of the user must be valid. There are several factors that contribute to Davis (1985) TAM model as shown in figure 2.4 below. The Technology is tested through the following factors: (1) External variables, (2) Perceived Usefulness and perceived ease of use, (3) Attitude towards using, (4) Behavioural intention to use, and (5) Actual system use (Davis, 1985). Our articulated TAM model for testing the acceptance of installing residential information systems in Swedish and German households will be discussed in Chapter 3 of this research.

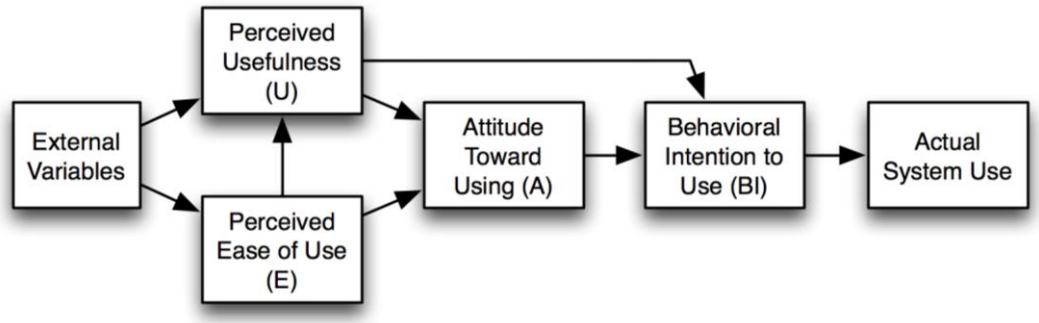

Figure 2.4 The Original Technology Acceptance Model (Davis, 1985)

2.4 Information privacy and misuse

Information privacy was defined by several scholars from different perspectives. Although the richest research done on information security is in still in the IS field, however information privacy has been also studied within other fields like law, governance, healthcare and other management (Bélanger and Crossler, 2011).

Historically, Information privacy evolved through 4 phases as classified by Westin (2003). Phase 0, early 40's till late 50's, where the information technology era was still evolving and information privacy was at ease. Phase 1, early 60's till late 70's, information privacy started to rise as a serious issue. Phase 2, early 80's till early 90's, information privacy regulations and acts were introduced by multiple European countries. And finally phase 3, early 90's till present, the internet was introduced and complex security systems and information security measures evolved rapidly (Westin, 2003).

In this section, we will focus on the definition(s) of information privacy and information misuse within the Information Systems field. While Belanger et al. (2002) defined information privacy as one's ability to control their personal information, Clarke (1999) also defined information privacy to be thought as a moral or legal right. The definitions may vary in context, but the main tenor is still the same.

Relating to our study, as stated in section 2.2 of this research, residential energy information systems include various types of data including personal and private household data which, as any other type of information, can be misused. After reviewing different literature on Information privacy and misuse, we learned that it can happen on different levels: (1) Individual (Westin, 2003) & (Agre and Rotenberg, 1998), (2) Group Level (Derlega and Chaikin, 1977) , (3) Organizational level (Thelwall and Stuart, 2006) & (Culnan and Bies, 2003) and (4) Social Level (Caudill and Murphy, 2000) & (Escudero-Pascual and Hosein, 2004).

As much as Information systems data collection and use of increasing amount of personal information adds value to organizations and their customers, it correspondingly raises information security and privacy concerns (Bloom et al., 1994).However the privacy paradox is that with no surprise, individuals "are willing to trade their personal information for perceived benefits " (Norberg et al., 2007). Personal information actual disclosure was studied by Sayre and Horne (2000) and found that "consumers would freely trade personal information in exchange for small discounts at a grocery store" (Sayre and Horne, 2000). That said, considering the nature and volume of energy and personal data that will be collected by residential energy

information systems, we will research the security concerns for implementing an energy information system into a residential unit. The questionnaire will include significant questions about personal and consumer information disclosure as well as questions about personal information security concerns, perceived risks, and perceived benefits.

Moreover, since privacy concerns and perceptions differ widely across nations and cultures and in some cases within the same segment (Mason and Culnan, 1995) (Nowak and Phelps, 1992). Thus, from this perspective, we decided to do our research between two countries: Sweden and Germany. Adding, there are multiple factors that can affect information privacy perception. Below is a list of the main factors: (1) Privacy awareness, (2) Privacy experience, (3) Personality differences, (4) Demographic, (5) Age, (6) Cultural and (7) Trust (Smith et al., 2011).

2.5 IS and Residential Energy Sustainability

Although there is still no full agreement on the definition of sustainability, however one of the first statements defined sustainability as "development that meets the needs and aspirations of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1985)

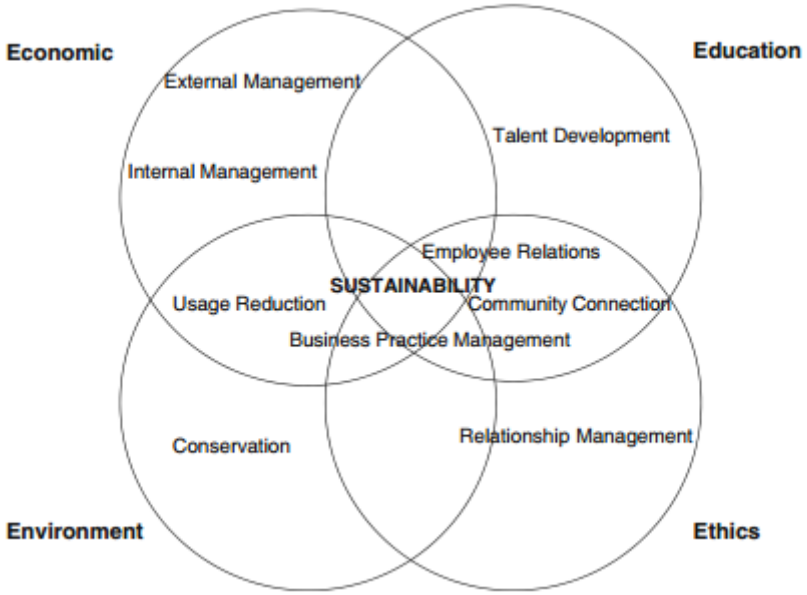

Figure 2.5 Dimensions of Sustainability (Closs et al., 2011)

The major dimensions of sustainability as described by Closs et al. (2011) are as following:

- Educational sustainability dimension reflecting issues related to talent development, employee relations, social connections and corporate management practices.
- Economical sustainability which reflects issues like external and internal management and usage reduction.
- Ethical sustainability dimension reflects issues related to individual and organizational relationship management, business practices in corporates, community connections and employee relations

- Environmental sustainability which includes conservation, usage reduction and best business management practices.

Any sustainability related issue is believed to be affected by the combination of the above dimensions. In our research, we are going to focus on four dimensions, and utilize it in our interview questionnaire. The nature of our research is limited to testing the technology acceptance of implementing an EIS into residential houses. Hence, we will be including a sustainability section in our questionnaire to test the awareness reflection of sustainable information systems solutions.

That said, energy is considered one of the major contributors to sustainability, and its ongoing towards and incremental and more scarce and hence costly resource (Wunderlich, 2013). “Many challenges have to be addressed in order to provide a seamless and sustainable supply of electric energy both in households (B2C) as well as industry (B2B)” (Wunderlich, 2013). The relation between both human behaviour and energy consumption, as mentioned in section 2.2.3, make it more complicated to have proper reports on energy consumption predictions. For the past decade, and as information technology have witnessed an exponential evolvement, “organizations leverage their productivity with an ever increasing rate of information technology and system (IT/S) use, they often become part of the larger problem of environmental sustainability (Jenkin et al., 2011).

However, utilizing “Green IT/S refers to information technology and system initiatives and programs that address environmental sustainability” (Jenkin et al., 2011), instead of becoming part of the problem it becomes the solution. “The effects of Green IT/S, which have the potential to be substantial, can be either (1) direct by reducing negative IT impacts on the environment or (2) indirect by using IS to support other business initiatives in reducing their negative environmental impacts” (Jenkin et al., 2011). In our research, the benefit of implementing energy information systems into households is indirect, in which information systems is used to support energy providers, vendors and the government with working towards enhanced energy efficiency. (Setterstrom, 2008) Green IT/S example shown in Table 2.1 below, is a good one on emphasising how information systems can be utilized into the energy sector to gain control on consumption, production and plan towards a strategic energy efficiency goal.

Green IT/S strategy types and Green IT/S examples.

Strategy type	Description	Examples	
		Green IT/S strategy	Green IT/S
Type 0: Image-oriented only	Involves portraying an image of caring about the environment by publicly announcing environmental policies (espoused strategy). These policies and practices are not subsequently implemented. Intentions can be "green" (authentic) or "greenwashing" (not authentic).	Announcing a strategy to reduce energy use in the organization's supply chain by using IT/S.	Although intentions are authentic, there are insufficient resources (for example, financial and human resources) to implement the IT/S application.
Type 1: Prevent, control, eco-efficiency	Involves making efficient use of natural and firm resources in order to reduce negative environmental impacts. Focuses on resource efficiency, waste prevention and control.	Introducing an objective to reduce IT/S power consumption across the company.	Implementing energy efficient servers and powering off PC's when not in use (Setterstrom, 2008).
Type 2: Product stewardship, eco-equity	Subsumes type 1 strategy and also involves attempts to achieve eco-equity goals (balancing the firm's and society's short and long term needs for natural resources) by minimizing environmental impacts throughout a product's lifecycle (product stewardship).	Developing a strategy to use IT/S to help reduce the environmental impact of an organization's product(s).	Implementing an IS and associated technology to capture environmental data during product distribution, use and maintenance for product design improvements (Yang et al., 2007).
Type 3: Sustainable development, eco-effectiveness	Subsumes type 1 and 2 strategies; involves infusing environmental sustainability considerations throughout all of the firm's activities and interactions with the goal of stopping environmental degradation altogether.	Introducing a goal to substantially reduce business travel using IT/S.	Implementing videoconferencing, telepresence and collaboration tools as substitutes for travel (Watson et al., 2008; Setterstrom, 2008).

Table 2.1 Green IT/S Strategy Types and examples (Jenkin et al., 2011).

2.5.1 Energy Metrics and Sustainability

Major "sources of sustainability data for IS researchers and other scholars in the administrative sciences is provided by corporate sustainability reports" (Melville, 2010). However, when it comes to studying and predicting residential energy consumption behaviour and the acceptance of inhabitants of implementing a new technology, reports are not enough to base our research on. As per (Melville, 2010) Sustainable energy metrics are classified into three categories: (1) renewable, (2) non- renewable, and (3) pollution in which each category is able to provide useful data for information system studies and analysis. In our research, we will take into consideration only category 1 and 2 since it's not possible to calculate pollution levels through our interviews.

2.5.2 Environmental Awareness

Similar to the energy consumption behaviour classification and factors by Hitchcock (1993), Melville (2010) mentioned that "Societal and organizational factors influence the beliefs, attitudes, and desires held by individuals". With no doubt, there are several factors affecting individuals and their awareness of sustainability, and energy consumption reduction is one of the most important factors in decreasing the world wide carbon footprint.

Till date, lots of research have been done on studying the relation between human behaviour and sustainable awareness, "Green IT/S studies describe how collecting and disseminating information about sustainability can help change cognitions, behaviours and routines" (Jenkin et al., 2011). Such studies discuss how information systems can help "change cognitions at both the individual and organizational levels by diffusing information about the need for changes in environmental practices" (Jenkin et al., 2011) & (Manning, 2007).

Moreover, the behavioural barriers to using a new technology as risk, uncertainty, learning constraints, knowledge, and behavioural drivers as fashions and social stress (Grubb et al., 2009) and (McNamara and Grubb, 2011). Adding, lack of knowledge is a necessary component to understand the environmental behavioural change (Stern, 2000). We can also see the importance of knowledge from the role it played in (Baddeley, 2011) behavioural analysis on climate change research. Finally, in this section, (Reynolds et al., 2010) emphasises on the lack of knowledge to analyse the environmental issues indecision and understanding gaps. However, (Pongiglione, 2011) argues "that behaviour change reflects an interplay of factors like perception, self-interest and limits to knowledge."

Chapter 3. Theoretical Background

Theme	Sub-areas	Literature
Technology Acceptance	Technology Acceptance Model (TAM)	(Davis, 1989); (Venkatesh et al., 2012); (Deschamps, 1988); (Goodhue, 1995); (Davis, 1985); (Fred D. Davis et al., 1989)
Perceived Usefulness		(Davis, 1989); (Thongpapanl et al., 2016); (Bonn et al., 2016); (Thongpapanl et al., 2016); (Susanto and Aljoza, 2015); (Thongpapanl et al., 2016)
Perceived Ease of use		(Davis, 1989); (Thompson et al., 1991); (Thongpapanl et al., 2016); (Mpinganjira, 2015); logistics (Shih-Min, 2015)
External Variables	Social Factors Participant Characteristics	(Kulviwat et al., 2007); (Bandura, 1986); (Compeau and Higgins, 1995); (Venkatesh et al., 2012); (Thompson et al. 1991); (Venkatesh and Davis, 2000)
Perceived Benefits		(Shang and Seddon, 2002); (García et al., 2016); (Mha, 2015); (barriers, 2014); (Yazici, 2014); (Lee et al., 2013); (Davis, 1989)
Perceived Risks		(Peter and Ryan, 1976); (Cunningham, 1967); (Jacoby and Kaplan, 1972); (Lee, 2009); (Kuisma et al., 2007); (Littler and Melanthiou, 2006)

Table 3.1 Theoretical Literature

In this section, we are going to have an overview of the technology acceptance model by (Davis, 1989) and describe the basic alterations we made to fit our research purpose. We will also discuss the Unified Theory of Technology Acceptance which was originally defined by Venkatesh et al. (2012) and list all the new constructs we added to original TAM.

3.1 Technology Acceptance

3.1.1 Technology Acceptance Model (TAM)

Originally, the basic concepts lining behind user acceptance model developed by (Davis, 1989) where defined as (1) Individual reaction to using information technology, (2) intentions to use information technology, and (3) actual use of the information technology. (Venkatesh et al., 2012) have also articulated the relation between these three concepts as shown in figure 3.1

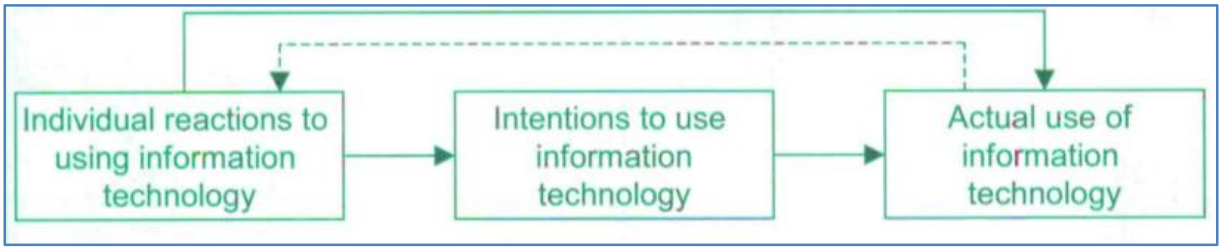

Figure 3.1 Basic concepts underlying user acceptance models (Venkatesh et al., 2012)

Prior information systems studies have researched the adoption and usefulness of any new information technologies, however there was different streams of the adopted research (Venkatesh et al., 2012). The first stream focuses on the individual technology acceptance, and the second stream focuses on the implementation success (Venkatesh et al., 2012).

The two most popular sources of individual technology acceptance are Davis (1989) and Compeau and Higgins (1995). On the other side he most popular literature sources on implementation technology acceptance are Leonard-Barton and Deschamps (1988), Goodhue (1995) and (Goodhue and Thompson, 1995)

Technology Acceptance Model (TAM) was a tailored model to information systems, and was basically designed to study and predict the technology usefulness and acceptance of information systems. The final thoughts of TAM exclude the attitude construct leading to a better understanding on the intention of use. The Core constructs of the original TAM model are Perceived Usefulness, Perceived Ease of Use, and a Subjective Norm if needed.

3.2 Perceived Usefulness

“The Degree to which a person believes that using a particular system would enhance his or her job performance” (Davis, 1989). In our research, and since residential energy information systems goals are both to prompt energy efficiency and lower the environmental impact of energy production, we will address usefulness from both economic and environmental perspectives.

In Davis (1989) TAM framework, perceived usefulness was theorised to be one of the direct interpreter of the attitude toward using a new technology. Moreover, it directly predicts the behavioural intention to use a new technology. Yet, perceived usefulness is affected directly by (1) external variables, which in our case will be social factors and personal characteristics, and (2) Perceived ease of use, which we will discuss in the following section.

In the context of our literature review, we came along several studies built on perceived usefulness. The studies conducted, were in the following fields: Risk management (Lin et al., 2015), Health care (Park et al., 2015), e-Commerce (Thongpapanl et al., 2016); (Bonn et al., 2016), e-Governance (Thongpapanl et al., 2016); (Susanto and Aljoza, 2015), Education (Thongpapanl et al., 2016) and Finance (Mpinganjira, 2015). However, it is unlikely we came across any acceptance studies made on energy information systems. Thus in the context of this research, perceived usefulness is one of the constructs in our model (see section 4.6), based on Davis (1989) which will pre-define the attitude towards using residential energy information systems.

3.3 Perceived Ease of Use

"The degree to which a person believes that using a particular system would be free of effort" (Davis, 1989). This indicator is based on the level of complexity to use the system as described by (Thompson et al., 1991).

In Davis (1989) TAM framework, perceived ease of use was theorised to be one of the direct predecessor of (1) perceived usefulness and (2) attitude toward using a new technology. While on the other hand, perceived usefulness is affected directly by (1) external variables, which in our case will be social factors and personal characteristics (see section 4.6)

Similar to what we have done in the previous section, we conducted a literature review on perceived ease of use and we came along several studies within various fields:, e-Commerce (Thongpapanl et al., 2016), e-Governance (Thongpapanl et al., 2016), Education (Thongpapanl et al., 2016); (Juhary, 2014), Finance (Mpinganjira, 2015) and logistics (Shih-Min, 2015). However, it is unlikely we came across any acceptance studies made on energy information systems. Thus in the context of this research, perceived ease of use will be used as one of the constructs in our model (see section 4.6), based on Davis (1989) which will pre-define the attitude towards using residential energy information systems.

3.4 External Variables

As any research model, TAM was criticized for mainly focusing on the cognition and disregarding the influence of personal emotion, culture and social factors when adopting a new technology (Kulviwat et al., 2007). Thus as external variables we have identified both social factors and personal characterises.

3.4.1 Social Factors and Information Systems

Social cognitive behaviour is one of the most influential factors of individual acceptance as defined by Venkatesh et al. (2012). The Social Cognitive Theory was introduced by Bandura (1986) and later extended by Compeau and Higgins (1995) where they studied computer use by extending the original Social Cognitive Theory (Bandura, 1986) to acceptance and information technology use, in which the following core factors were included:

- Outcome expectations – Performance: Performance related consequences of the behaviour like performance expectations of the IT/S solution (Compeau and Higgins, 1995)
- Outcome expectations – Personal: Personal related consequences of the behaviour like the individual self-esteem and sense of accomplishment (Compeau and Higgins, 1995).
- Self-efficacy: Judging the ability of an individual to use technology (Venkatesh et al., 2012).
- Affect: Information Technology individual's likelihood (Venkatesh et al., 2012)
- Anxiety: building a sense of unrest when using a new technology (Venkatesh et al., 2012)
- In social cognition, individuals "function as contributors to their own motivation, behaviour, and development within a network of reciprocally interacting influences." (Bandura, 1989)

On the other hand, Social Factors were defined by (Thompson et al. 1991) as "The individual's internalization of the reference group's subjective culture. and specific interpersonal agreements that the individual has made with others, in specific social situations." In other words, the social factors are an interrelated means that affect the behaviour of a single individual towards using and accepting a new technology.

Social factors play a significant role in influencing the individual technology acceptance decisions, in which it "has an impact on the individual's behaviour through three mechanisms (1) Compliance, (2) Identification, and (3) Internalization" (Venkatesh and Davis, 2000). In our research, we will elaborate a bit more on the Social behaviour constructs and social factors, in the research model section of this thesis in which Social Factors are demonstrated to be an external variable which directly predecess both perceived usefulness and perceived ease of use (see section 4.6).

3.4.2 Participant Characteristics

In recent studies and research, personality was described as a conventional and stable relationship of oneself with the internal and external situations and the interrelation with all of ones personal characteristics (Özbek et al., 2014). Originally, (Allport, 1961) described the personality as a "dynamic organisation within the individual of psychophysical systems that determine his characteristic behaviour and thoughts".

Moreover, personality was described as "the characteristics pattern of thoughts, feelings, and behaviours that distinguishes one person from another and that persists over time and situations" (Phares and Chaplin, 1997).

Lately, and with the rapid growth of information and communication technology. The interest in personality characteristics has been on the radar of information systems researchers (Nov and Ye, 2008). Personality characteristics are believed to prompt alter indivisibles behaviour based on various situations (Thatcher and Perrewe, 2002); (Pratt and Chudoba, 2006). For example, the teacher's personality directly affects the perceived usefulness and ease of use in Yeh et al. (2011) e-learning systems TAM study. On the other hand, Özbek et al. (2014) described how personal characteristics affect the usefulness of mobile phones, and Escobar-Rodríguez and Romero-Alonso (2014) studied thoroughly the relation between the TAM constructs and the personal traits.

In the context of our research, personality characteristics will be listed as an external variable that predecess perceived usefulness and ease of use. Our focus will be on the resistance to change which is considered a critical issue for technology (Manzoni and Angehrn, 1997).

Personality Characteristics assist in interpreting one's responses, in which different personality traits result in different interpretations (Antil, 1984). Moreover, Personality characteristics are believed to be influenced by prior knowledge and vice versa (Ackerman, 1996). And finally on this section, (Landers and Lounsbury, 2006) sees the importance of personality characteristics by determining the personal values, attitudes and behaviours.

3.5 Perceived Benefits

Information systems benefits were divided by Shang and Seddon (2002) into five dimensions: (1) operational, (2) managerial, (3) strategic, (4) infrastructural, and (5) organisational. However, due to nature of the product we are studying, the benefits will be focusing on the operational and managerial dimensions only. Personal benefits are considered part of the operational benefits which are defined as the day to day operations and productivity enhancements (Shang and Seddon, 2002). Nevertheless, "managerial benefits are indicated by improved resource management, improved quality of planning and decision making…"(Shang and Seddon, 2002). Yet, since one of the main goals of an EIS is to improve energy efficiency and prompt sustainability. We will be considering environmental benefits as part of the perceived benefits of a residential information system. This will show in our interviews questions, and analysis later in this thesis.

We came along several studies built on perceived benefits. The studies conducted, were in the following fields: Quality assurance (García et al., 2016), Mobile banking (Mha, 2015), Health care IS (barriers, 2014), medical (Yazici, 2014), social networks (Lee et al., 2013). Similar to the constructs before, we unlikely came across any acceptance studies made on energy information systems. Thus in the context of this research, perceived benefits is one of the main constructs in our model (see section 4.6), based on Davis (1989) which will pre-define the attitude towards using residential energy information systems.

Perceived benefits expected from an EIS are different from ones in any other field. the classification is dependent on the type of product or service that is being studied. Perceived benefits are directly affected by perceived risks. More discussion on risks in the following section.

3.6 Perceived Risks

Perceived risk was properly defined on a consumer level in the late 70's by (Peter and Ryan, 1976) yet defined also as a kind of "subjective expected loss". Possible loss was also mentioned in Featherman and Pavlou (2003) definition, defining "perceived risk as the possible loss when pursuing a desired result". However, one of the most important notations is that "perceived risk consisted of the size of the potential loss" in other words, it's ones expectation of failure results while doing an action which in reality the action itself lead the result to fail (Cunningham, 1967).

Although perceived risk was broken down into six dimensions, which have been classified by Jacoby and Kaplan (1972) as (1) financial, (2) performance, (3) social, (4) physical, (5) privacy, and (6) time-loss. However, after more than thirty years of this classification, the understanding of the risks dimensions evolved. Currently the understanding is that the classification is subject to variation based on the service (Featherman and Pavlou, 2003). We selected the below dimensions which match with the product (EIS), originally listed by Lee (2009).

- *Performance Risk:* this dimension defines the relation between both perceived risks and perceived benefits. "Defined as the possibility of the product malfunctioning and not performing as it was designed and advertised and therefore failing to deliver the desired benefits."
- *Social risk:* this dimension declares the relation between social factors and perceived risks. It was defined as "the potential loss of status in one's social group as a result of adopting a product or service, looking foolish or untrendy." (Lee, 2009)
- *Financial risk:* This dimension is defined as the "probability that a purchase results in loss of money as well as the subsequent maintenance cost of the product" (Kuisma et al., 2007). It relates to the personal characterises to the use.
- *Privacy risk:* it was defined as the" potential loss of control over personal information, such as when information about you is used without your knowledge or permission." (Littler and Melanthiou, 2006).

Chapter 4. Methodology

The purpose of this thesis is to answer the research question *"Do Swedish and German residents accept the use of residential energy in-formation systems?"* which has been done though reading literature that studies different factors that can affect technology acceptance, EIS, data gathering, and energy consumption within residents. We decided to divide the research question into these parts since it is a good practice to divide the principal problem into more manageable sub problems when conducting research (Hevner and Chatterjee, 2010).

4.1 Research Strategy

First of all, we decided that there was an importance of gaining a deeper understanding of EIS, how it is implemented, and what is expected of the system and the user. This was done through interviewing Rikard Roth, the CEO of Roth Fastigheter AB, who are offering their tenants climate-smart solutions for their home (Hyllie1, 2016). Secondly, we interviewed 20 randomly selected people, 10 people with Swedish origin and 10 people with German origin, in order to see if there are any differences between the two countries and their ability to accept new technology which includes dealing with personal and consumption data gathering.

4.2 Data Collection Techniques

We first interviewed Rikard Roth in order to understand more about EIS, how they are implemented and what precautions are made in order to assure user and technology acceptance.

We then conducted interviews in order to study user and technology acceptance and its effect on EIS using the emergent meaning method (Recker, 2013). This method focuses on uncovering and learning the meaning of behaviour, opinions, or views that participants have about a phenomenon (Recker, 2013). We therefore used it in order to understand their behaviour, opinions, and views of EIS, their energy consumption, data gathering, and the ability to change and adapt. While the informants in Sweden were interviewed face to face the informants from Germany were interviewed through a phone call.

4.3 Informant Selection

We decided to interview Rikard Roth, who is the CEO of Roth Fastigheter AB, who in 2013 launched their new energy-smart residential buildings in Hyllie, Malmö, Sweden (Fastigheter, 2013a). Roth Fastigheter AB were the first to build residents in Hyllie and one of the first in Sweden that offer their tenants climate-smart solutions in their home (Hyllie1, 2016). Roth Fastigheter AB was chosen since it is the first in Sweden that meet the high environmental standards as part of the EU project Build Smart, which aims to promote the trend towards building more energy efficient buildings in Europe (Fastigheter, 2013a). Roth Fastigheter AB wants to deliver a simple, clear, practical, and money-saving system through sensors in each room, sleep mode for during vacation, and the ability to manage the system through a screen in the hall, on the computer and on your phone (Fastigheter, 2013a), which is why we believe that Rikard Roth from Roth Fastigheter AB is the right company to interview.

We then decided to choose the rest of the informants randomly according to their age groups and profession is order to avoid sampling bias (Bhattacherjee, 2012). We are focusing on only two countries in order to be able to compare the different cultures and how it can play a part in technology acceptance. We selected Sweden and Germany, relying on the world web index ranking for the impact of information freedom on environmental issues in Sweden and Germany (Index, 2014)

4.4 Interview Guide

Appendix 1 holds the interview guide key, which is based on the literature framework in order to answer the research question: Do Swedish and German residents accept the use of residential energy information systems? The Interview Framework (see Table 4.1) gives and understanding of how the questions are built and how they are connected to the literature framework. The larger part of the interviews was done with the residential consumers since numbers are important when assumptions are to be made on the masses. In order to gather information about the informants, Informant Profile questions were asked. This gave the ability to define the background of the expert while understanding the residential consumers.

4.5 Data Analysis

Theme	Key Areas	Questions
Energy Information System (EIS)	Residential Energy Information System (REIS) Residential Energy Data and Informatics Residential Energy Consumption Behaviour • Human Factor • Physical Factor	Exp00 Q00
IS and Residential Energy Sustainability	Energy Metrics and Sustainability Individual and Organizational Sustainability	
Technology Acceptance	User Acceptance Technology Acceptance Model (TAM)	
Information Security	Residential Energy Information Security and Sensitivity ➢ Energy Data use	
Social Behaviour and Information Systems	What is the level of social stress/pressure when deciding to use and accept a new technology?	
Participant Information	Who is the participant and what is their relationship to EIS and energy consumption?	
Usefulness	Do you find EIS useful?	
Ease of Use	Do you find it easy to use?	
Benefits	What benefits are there using an EIS?	
Social Factors	What affects you about the choice of technology?	
Risks	Are there any risks with data gathering and can you trust it?	

Table 4.1 Interview Question Framework.

Qualitative analysis is the analysis of qualitative data, such as interview transcripts and case studies (Bhattacherjee, 2012). This type of analysis is mainly dependent upon the researcher's ability to have analytic skills and personal knowledge of the social context where

the data is collected (Bhattacherjee, 2012). Since our data is a combination of both open answers and limited answers, we will be using both (1) text analysis and (2) charts and graphs analysis.

Tableau is a software that we will use to create visual informative graphs and will be the basis of this data analysis. On the other hand, Memoing is a technique that is used directly after the collection of data in order to summarize the observations for easier analysis later on (Recker, 2013), we will use this technique to take note of any variations and coo relations between the constructs.

Since the data we collected is related to human behaviour and circumstantial factors, the best analysis approach is the Interpretivist Approach (Lacity and Janson, 1994). Thus, our text analysis will be concentrated on (1) Research Methods understanding of how culture and experiences influence the text interpretation, (2) assuming that the Natural text language is subjective, the speaker, listener, and observer and (3) Validity checks approaches prescribing the least formalized evidence (Lacity and Janson, 1994).

4.6 Research Model

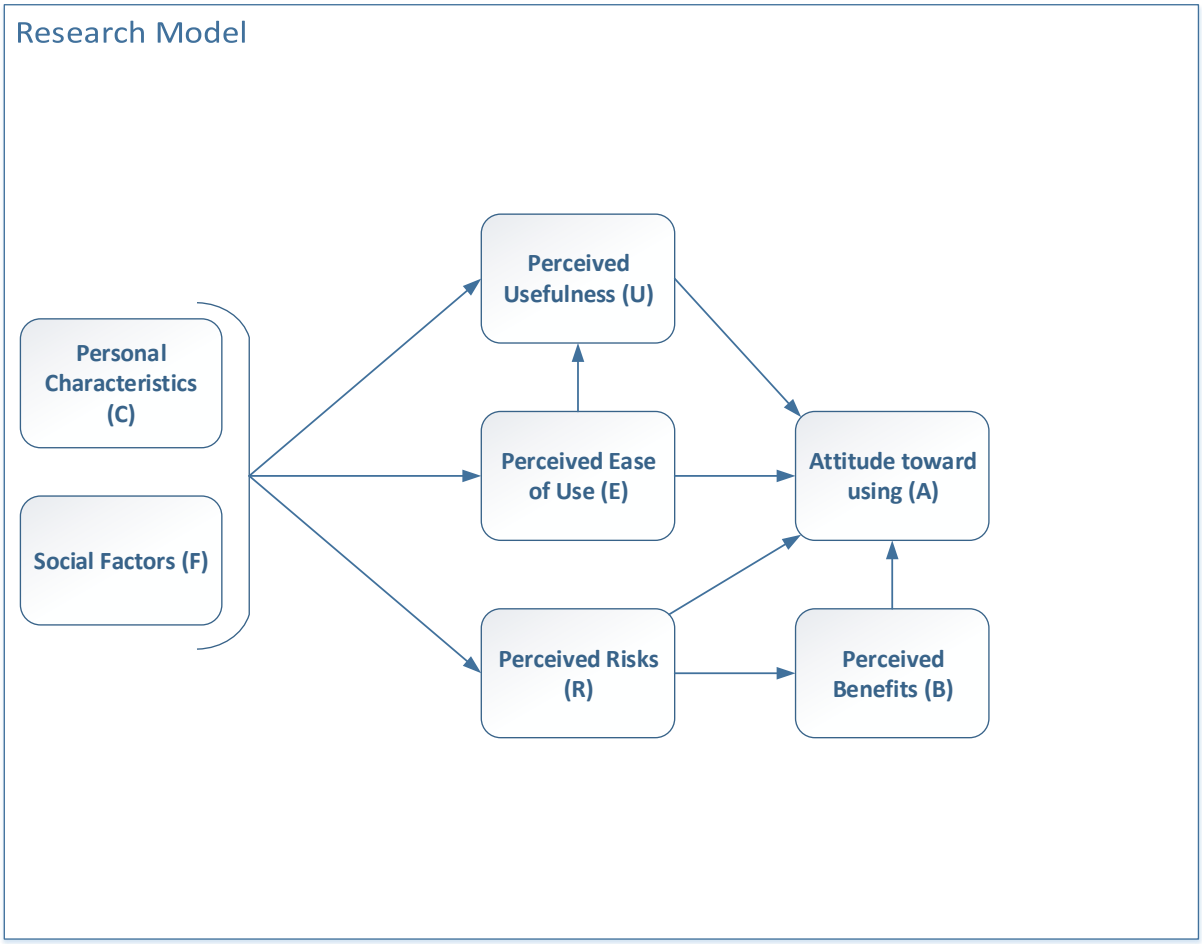

Figure 4.1 articulated based on the Original Technology Acceptance Model (Davis, 1985)

Our Research Model is built based on (Davis, 1989) TAM model, in which the external variables were identified as Participant Characteristics (Allport, 1961); (Phares and Chaplin, 1997); (Landers and Lounsbury, 2006) and Social Factors (Davis, 1989); (Compeau and Higgins, 1995); (Venkatesh et al., 2012); (Bandura, 1989). Perceived Usefulness, Perceived Ease of Use and the Attitude towards using a new tech were adopted also from (Davis, 1989) TAM model. We also added two more constructs that are also believed to have a direct impact on accepting a new technology solution: (1) Perceived Risks (Peter and Ryan, 1976); (Lee, 2009); (Kuisma et al., 2007); (Littler and Melanthiou, 2006) and (2) Perceived Benefits (Shang and Seddon, 2002); (García et al., 2016); (Mha, 2015); (Lee et al., 2013).

4.7 Research Quality

4.7.1 Reliability and Validity

When conducting a study the quality of the research should be considered, both in terms of reliability and validity (Recker, 2013). The accuracy of measurement is also important since the researchers need to have accuracy in their data in order to faithfully demonstrate their findings (Recker, 2013). Two requirements in order to avoid such problems are validity and reliability, reliability standing for the fact that the same research could be conducted in similar settings and get the same results, while validity is the fact that the data collected really is what the researcher was sent out to find (Recker, 2013). Both need to be faced in order for the research to have meaning as seen in Figure 4.2. The research that I will conduct will go through a similar measurement in order to ensure its reliability and validity.

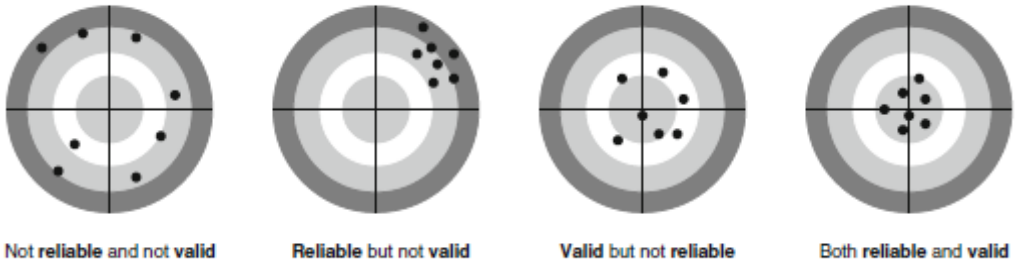

Figure 4.2 The measurement of reliability and validity. (Recker, 2013)

4.7.2 Bias

When Rikard Roth from Roth Fastigheter AB is being interviewed it is important to consider that he will talk about all the positives and not the negatives about his company. They themselves write on their website, translated from Swedish, that “In order to get the indoor environment that you enjoy and at the same time be able to influence the energy costs, we are introducing a very orderly and efficient energy measurement system for electricity, heat and water in all apartments.” (Roth Fastigheter 1, 01.08.2016). The Principle of Suspicion which requires sensitivity to biases and systematic distortions in the collected narratives, were we will be in direct contact with the examined person or community and objectivity is subject to avoiding biases as much as possible (Klein and Myers, 1999).

4.7.3 Ethical Considerations

We have followed principles defined by Klein and Myers (1999) for conducting and evaluating interpretive field studies in information systems. First, using the Principle of Contextualization which requires critical reflection of the social and historical background of the research setting, and in our case (Klein and Myers, 1999), the social and cultural aspects are highly present. Second, the Principle of Interaction between the researchers and the subjects which requires critical reflection on how the research materials are socially constructed through the interaction between the researchers and participants, and in our case the interaction was present when conducting the interviews (Klein and Myers, 1999). Third, the Principle of Multiple Interpretations which requires sensitivity to possible differences in interpretations and expressions of multiple narratives that leads to the sequence of events, and since behavioural changes of people is highly dynamic we had to abide by this principle (Klein and Myers, 1999).

We also made sure that the data collected would be anonymous, which is one of the main principles of doing ethically correct research (Bhattacherjee, 2012), where all the data collected should not point to any person or household. Second principle is Disclosure (Bhattacherjee, 2012), as the statistical data will be retreated from ready sources. Third consideration is Analysis and Reporting (Bhattacherjee, 2012), since we are using collected data from households and statistical data about their energy consumption, we will have an ethical liability to document how data is analysed and reported (Bhattacherjee, 2012).

Chapter 5. Empirical Findings and Data Analysis

After demonstrating the methodology above, the below sections will list our analysis of the empirical findings from 20 participants'. We will structure the findings in the order of our research model, and then analyse the findings accordingly.

5.1 Informant Profiles

Table 5.1 describes the shortcuts that are being used when discussing a specific informant. In our research we have interviewed 4 experts in both the fields of information systems and residential energy. In table 5.1, these interviewees are listed as Informants. Nevertheless, table 1 also list all the 20 participants who took our questionnaire. All of the 20 participants are residential energy consumers.

Code	Description	Informant ID
I01	Informant 1	Rikard Roth, CEO of Roth Fastigheter
P01	Participant 1	Resident
P02	Participant 2	Resident
P03	Participant 3	Resident
P04	Participant 4	Resident
P05	Participant 5	Resident
P06	Participant 6	Resident
P07	Participant 7	Resident
P08	Participant 8	Resident
P09	Participant 9	Resident
P10	Participant 10	Resident
P11	Participant 11	Resident
P12	Participant 12	Resident
P13	Participant 13	Resident
P14	Participant 14	Resident
P15	Participant 15	Resident
P16	Participant 16	Resident
P17	Participant 17	Resident
P18	Participant 18	Resident
P19	Participant 19	Resident
P20	Participant 20	Resident

Table 5.1 Informant Key and Description.

5.2 Participant Characteristics

The data summary below in table 5.2 demonstrates our participant's basic characteristics, listing Age, Gender, Country, Residence, Energy Information Systems Availability, and Tech Literacy.

Participant	Age	Gender	Country	Own Residence?	EIS	Tech Literate	# of Residents
P01	28	Female	Germany	NO	No	Yes	3
P02	24	Male	Germany	Yes	No	Yes	1
P03	54	Male	Germany	Yes	Yes	Yes	2
P04	64	Male	Germany	NO	No	No	2
P05	46	Female	Germany	Yes	No	Yes	2
P06	23	Female	Germany	Yes	Yes	Yes	3
P07	32	Male	Germany	Yes	No	Yes	1
P08	33	Male	Germany	Yes	No	Yes	5
P09	30	Male	Germany	Yes	Yes	Yes	1
P10	38	Male	Germany	NO	No	Yes	4
P11	29	Male	Sweden	Yes	No	Yes	2
P12	26	Male	Sweden	Yes	No	Yes	2
P13	23	Female	Sweden	Yes	No	No	2
P14	32	Male	Sweden	Yes	No	Yes	1
P15	25	Male	Sweden	Yes	No	Yes	1
P16	26	Female	Sweden	Yes	No	Yes	2
P17	32	Male	Sweden	Yes	Yes	Yes	2
P18	23	Female	Sweden	NO	Yes	Yes	3
P19	27	Female	Sweden	Yes	Yes	Yes	2
P20	27	Male	Sweden	Yes	No	Yes	1

Table 5.2 Personal characteristics of participants

20 participants in which 10 are living in Sweden and another 10 in Germany. The reason we chose two different countries, is to study any social or cultural factors that can affect the attitude towards using a new technology.

In our interviews questionnaire, the 20 participants were asked to fill in anonymous personal information (basic questions as mentioned above). Participants were asked for their age, where our age targeting range was between 18 and 65. The minimum age of our participants is 23, maximum age is 64 and resulting in a median of 28.5. Within the 20 participants, we have 30% females and 70% males in which 7 males and 3 females are from Germany, and 6 males and 4 females from Sweden. All our participants own or rent their own house. Yet, only 6 participants (3 in Germany and 3 in Sweden) happened to have a type of an Energy Information System implemented in their residents.

Sort	Response Choice	Share of respondents %
Age	<30	9
	>30	11
Gender	Male	13
	Female	7
Tech Literacy	Yes	18
	No	2
Location	Germany	10
	Sweden	10

Table 5.3 Responses on Personal characteristics section

From the 20 participants, only 2 participants happened to have no technology literacy. Although it is rare to find young participants who are tech illiterate these days, yet in our records P07, a 23 years old female and also P04, a male with an age of 64 are both tech illiterate.

Moreover., Six of our participants live alone, and the rest of the 14 participants have other residents living with them. Energy consumption within a household usually is believed to increase with the number of people living in the same resident.

After listing the findings above, we are going to analyse the personal traits of our 20 participants based on their country. Table 5.4 below list the findings found based on our questionnaire in both Germany and Sweden.

- Participants from Sweden

Participant	Age	EIS	Tech Literate	Care for Environment?	Environmental Awareness	Privacy Importance
P11	29	No	Yes	Yes	Yes	A Little
P12	26	No	Yes	Yes	Yes	Very Important
P13	23	No	No	Yes	Yes	Moderate
P14	32	No	Yes	Yes	Yes	Very Important
P15	25	No	Yes	Yes	No	Moderate
P16	26	No	Yes	Yes	Yes	A Little
P17	32	Yes	Yes	Yes	Yes	Very Important
P18	23	Yes	Yes	Yes	Yes	Moderate
P19	27	Yes	Yes	Yes	Yes	Moderate
P20	27	No	Yes	No	Yes	Moderate

Table 5.4 Personal characteristics of participants from Sweden

From the 10 participants who are living in Sweden, the media age is 26.5 and only P07 is tech illiterate who is 23 years old. So we can say that 90 % of our participants know the basics of using a tech device or solution. Moreover, 90 % of the responses about environmental awareness came positive except for (1) P13 who replied “No” to Q11 yet replied “Yes” to Q10 which means although P13 does care for the environment, however by believing that energy consumption does not affect the environment he shows low environmental awareness, and (2) P20 who replied as “Yes” to Q11 and “No” to Q10. P20is apparently believes that increased energy consumption may affect the environment badly, yet showed no care for environmental issues.

Moreover, P17, P18 and P19 have Energy Information System implanted in their residents. Considering that this research is oriented to study the tech acceptance prior to implementing EIS in households, we believe that the responses from these three participants can be used to add more value in validating the outcome of this research.

Privacy importance traits within the participants from Sweden showed a variation. We used a scale of 1 to 3 (Little, Moderate, Very Important), where 20% of the participants replies “A Little” when asked if they are keen to keep their privacy, 40% replied “Moderate” and 30 % replied “Very Important”.

- Participants from Germany

Participant	Age	EIS	Tech Literate	Care for Environment?	Environmental Awareness	Privacy Importance
P01	28	No	Yes	Yes	Yes	Very Important
P02	24	No	Yes	Yes	Yes	Very Important
P03	54	Yes	Yes	Yes	Yes	Very Important
P04	64	No	No	No	Do not Care	Very Important
P05	46	No	Yes	Yes	Yes	Moderate
P06	23	Yes	Yes	Yes	Yes	Moderate
P07	32	No	Yes	Yes	Yes	Moderate
P08	33	No	Yes	Yes	Yes	Very Important
P09	30	Yes	Yes	Yes	Yes	Very Important
P10	38	No	Yes	Yes	Yes	Very Important

Table 5.5 Personal characteristics of participants from Germany

From Germany, only P04 is tech illiterate. Thus, 90 % of the participants from Germany know the basics of using a tech device or solution. Moreover, 90 % of the responses about environmental awareness came positive except for P04 who replied “No” to Q10 and “Do not Care” to Q11.

Similar to the participants from Sweden, in the German sample, we also happen to have 3 participants who have EIS implemented in their residents. P03, P06 and P09 response will also add value towards validation our findings.

Privacy importance traits within the participants from Germany showed a quite different orientation towards being more conservative when it comes to personal privacy. 70 % of the participants replied “Very Important” when asked if they are keen to keep their privacy and only 30% replied “Moderate”. These concerns are not fake, as we got confirmation from I01 when asked whether the company stores personal information on their customers and the answers was “yes, due to billing purposes and a general interest in running the building efficiently.”

5.3 Social Factors

In this section we asked 3 major questions to study the social factors that usually affect the participants whenever choosing and accepting a new tech solution or device. Similar to the approach followed in the previous section, we will list and analyse the empirical findings on the country level.

First, in Sweden 40% of the participants stated that they use a new technology because the majority around them are using it. While 60 % responded that they do their own research prior to using a new tech device or solution. On the other side, Q26 tests the social pressure on the participant. Figure 5.1 shows the responses of the participants on Q26, where we can see that 50 % of the response came “Moderately affected” by what they hear around them, and 20% are highly affected. Leaving little, very little and very high affected by social stress with 10% each. Figure 5.2 Shows that 50% of the participants in Sweden tend to seek advice from friends before buying a new tech device or solution, while 30% sometimes do and 20% never do.

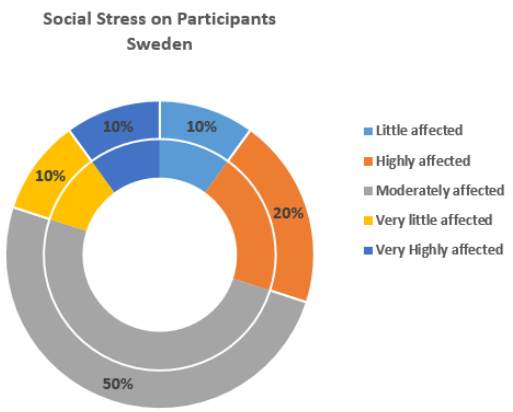

Figure 5.1 Social Stress on Swedish Participants

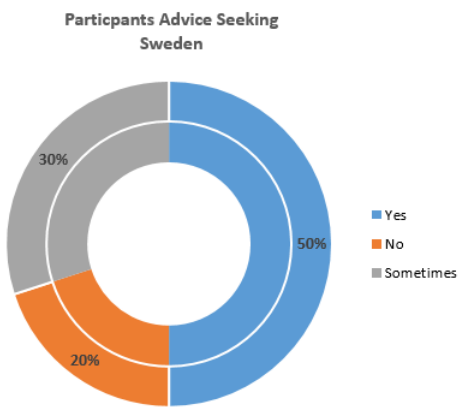

Figure 5.2 Swedish Participants Advice Seeking

Second, the responses from Germany had a different orientation where 80% of the participants stated that they use a new tech because they did their own research while only 20% do use it because someone they know did. Moreover, and similar to the Swedish percentage, 50% of the participants in Germany are "Moderately affected" by what they hear around them. However, 20% on the other hand are "little affected", 10% are "very little affected" and 0% "very highly affected".

Figure 5.4 shows that 80% of the German participants have tendency to "sometimes" seek advice from a friend before purchasing a new tech.

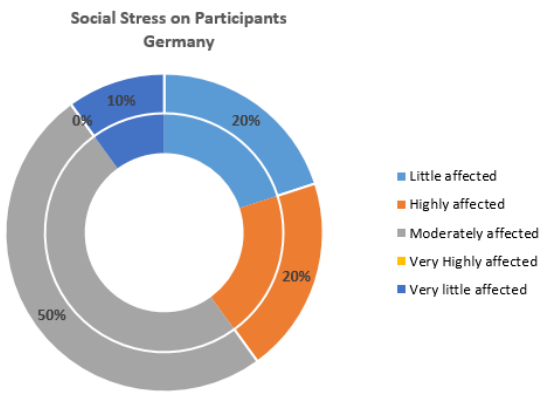

Figure 5.3 Social Stress on German Participants

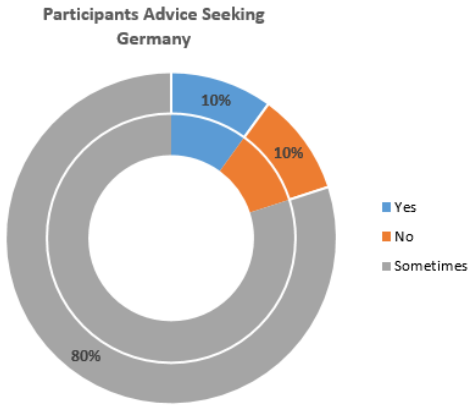

Figure 5.4 German Participants Advice Seeking

5.4 Perceived Usefulness

In this section, we asked the participants 3 questions to determine the perceived usefulness of an EIS in households. We will list and interpret the empirical findings on the country level similar to the previous sections.

First, while 7 out of the 10 participants from Sweden answered "Yes" on the open question Q13. P11 answered "Perhaps". P20 expressed his interest depending on the price of the product by stating "Yes, depends on the price", P15 concern on the other side is about the maintenance of the product, as he stated "if it was low maintenance" and finally P17 who stated "Yes, if the information is good enough" raising the concern about whether the solution will provide him with any valued information or not.

Q14 was answered based on a general explanation to check whether our participants value the usefulness of sustainable tech solutions. Both questions were open direct questions. While, 6 responses came as "Yes", we got some extra concerns from other 4 participants. P11 condition to consider the solution feasible is to have a low price and to operate properly stating "If it works, is cheap and non-invasive". P06 and P12 both also are concerned about the price, stating "Yes, if it's not too expensive" and "…it depends on the costs…" Moreover, P17 and P15 were more eager to have a specific solution. We could not interpret whether the response is a positive or negative.

When asked about whether energy consumption is an environmental problem or not, 5 participants from Sweden answered "Yes" on Q15. P15, P16, and P18 answered were negative stating phrases like "Not at all" and "No Idea" which confirms a low environmental awareness level. P14 and P17 were more descriptive and positive that energy consumption is in fact an environment problem stating phrases like "Yes. Very much so" and "Yes, at the moment it is".

Second, while 8 of the German participants answered a direct "Yes" when asked if they would make use of an EIS at their households, the other 2 participants had other views. The German participants showed a more positive perceived usefulness towards residential EIS solution. 8 out of the 10 participants gave a positive response by stating phrases like "Yes", "Why not", "I believe so". Yet, 2 other participants had different concerns like cost "depends on cost" (P04) and ease and fun of the system "depending on how easy and how fun the system is to use" (P01).

When asked if an EIS is a feasible idea, 9 participants were positive stating their agreement with statements like "Yes", "Probably Yes" and "Definitely". Also, the responses on whether energy consumption is an environmental problem in Q15 came mostly positive with 7 responses like "Yes", "Definitely" and "It has probably an impact on the environment". P01 however believes that if the energy is a "green energy" it won't be a problem.

On the other side, I01 agreed that EIS are an effective tool to reduce energy consumption. The reason is that customers will have a direct visibility on their consumption patterns (I01). And when asked if it is a feasible idea whether to implement an EIS, his answer was "Yes". Thus, and from a practical point of view we believe that an EIS in households both environmental and economical (I01).

After listing the findings on usefulness in both German and Sweden participants, we can state that based on our interviews and the sample, Germans who participated in the interviews are more environmentally aware than the Swede participants. This reflects in the positive perceived usefulness the German participants gave towards implementing an EIS in households and the environmental benefits behind it.

5.5 Perceived Ease of Use

This section will analyse the answers that the Swedish and German residential participants gave that are connected to their perceived Ease of Use. Each question will be analysed, comparing it to the different countries or different questions. This section will also analyse the answers given by Rikard Roth.

85% of the people answered "Yes", to the question if they find it easy to use an application on a phone or a tablet. One man in Sweden thinks that it is easy to use it, although he prefers using a computer (P17), while one woman in Germany says that it "depends on the application, mostly it's easy" (P06). The following figure (see Figure 5.5) shows how the answers were grouped per country, showing that there isn't a big difference between the two countries in this question.

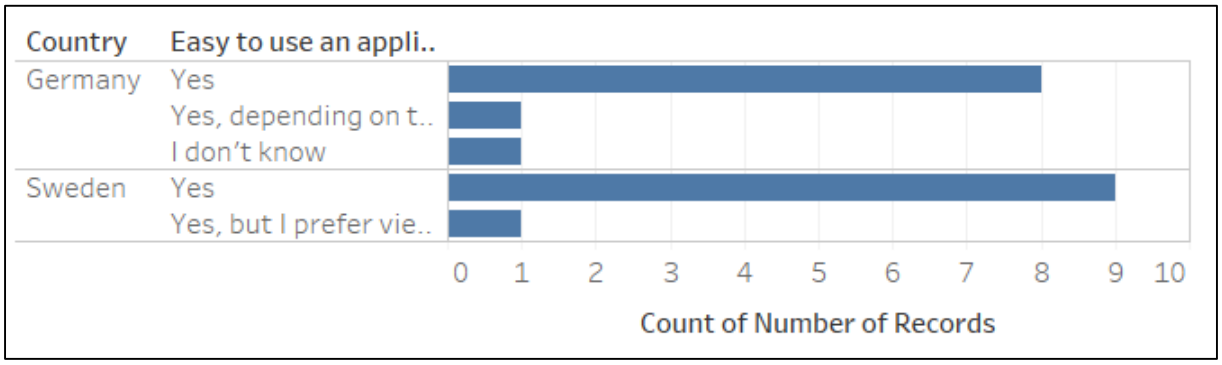

Figure 5.5 Ease of Use grouped by Country.

I01, our informant on EIS, answered that there is "more to do in this area. GUI needs to be developed further", talking about their own application.

None of the participants feel like they need help or training when faced with a new application. I01 believes that there is a need for help and training when using a new application. "yes, we have shown the system numerous times and also made videos and brochures" (I01).

If you would have an EIS implemented in your household, who would be using it?

Figure 5.6. Who should be using EIS grouped by Country.

The woman in Germany who didn't know if she thought it was easy to use an application is the only person in Germany that believes that all family members should be allowed to use the EIS. While the remaining 9 people in Germany believes that only the Adults should be using the EIS.

However, 60% of the Swedish participants answered that they believe that only the adults should be using the EIS while 40% believed that all family members should be using it.

The figure (see Figure 5.6) shows the answers grouped by country. Germany being grey and Sweden being yellow.

5.6 Perceived Benefits

This section will analyse the answers that the Swedish and German residential participants gave that are connected to their perceived Benefits. Each question will be analysed, comparing it to the different countries or different questions. This section will also analyse the answers given by Rikard Roth.

70% answered that companies will understand energy consumption trends and behaviour better if the information is being shared while only 5% said that it won't. 20% answered that they don't know. Figure 5.7 shows that there is no significant difference between Sweden (yellow) and Germany (grey).

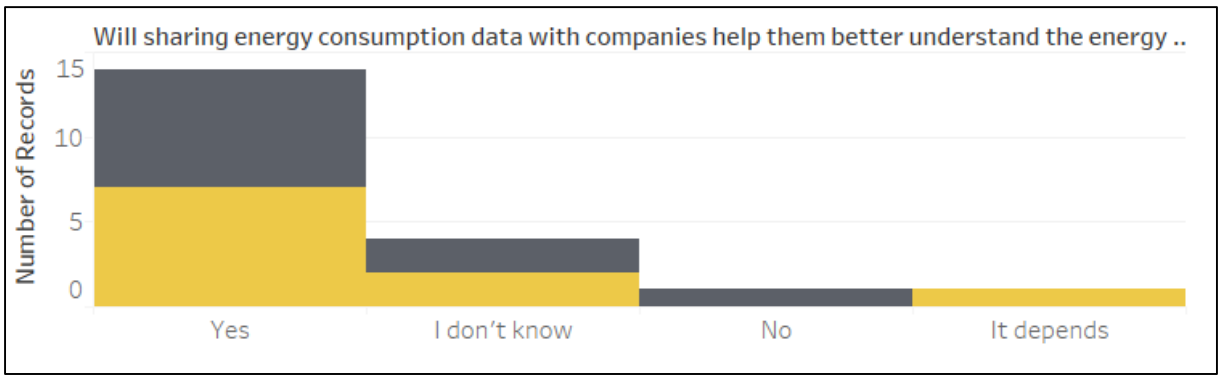

Figure 5.7. Benefits of Sharing grouped by Country.

Our informant, Rikard Roth (I01), simply answered "Yes" to "Does gathering energy consumption data help to better understand the energy consumption trends and behaviour in residential sector?".

90% of the people answered "Yes" to if an EIS would help in reducing their energy consumption. There was no difference when comparing origin of the participants.

The monthly expenditure for the people answering "Yes" is on average 784,4 kr. While the people answering "No" spend on average 640.0 kr per month on energy costs.

There is no difference compared to how many people live in the residence when it comes to answering "Yes" or "No" on whether EIS would help in reducing energy consumption. The people that answered "Yes" have on average 2 people in their residence while the people answering "No" have on average 2 people in their residence.

The people who answered "No" have on average larger residents in square meters. They have on average 427,8 m2, while the people who answered Yes have on average 115,9 m2.

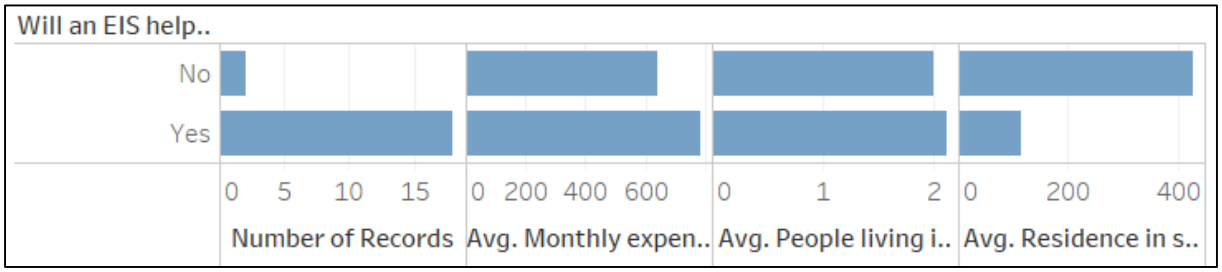

Figure 5.8. EIS help in reducing energy consumption.

I01 believes that an EIS can reduce the energy consumption, although he also mentions that there is a need of a money incentive that is big enough.

As a last comment I01 mentioned that "Doing these installations brings you a future safe building. Eventually energy will become more expensive and people will start to care more.".

75% of the people answering if they find it interesting and beneficial to monitor their appliances remotely answered "Yes". Those people had reasons like "…in the case I forget something and it can be used when I am not in the room so that I can see whether in other rooms energy can be saved" (P02), "…you have a better overview over everything" (P06), "To reduce consumption when I am not at home. And increase in preparation for me returning." (P09), "You will realise that there is a lot of unnecessary energy being wasted. And you can turn on certain appliances on your way home instead of having them turned on all the time." (P20).

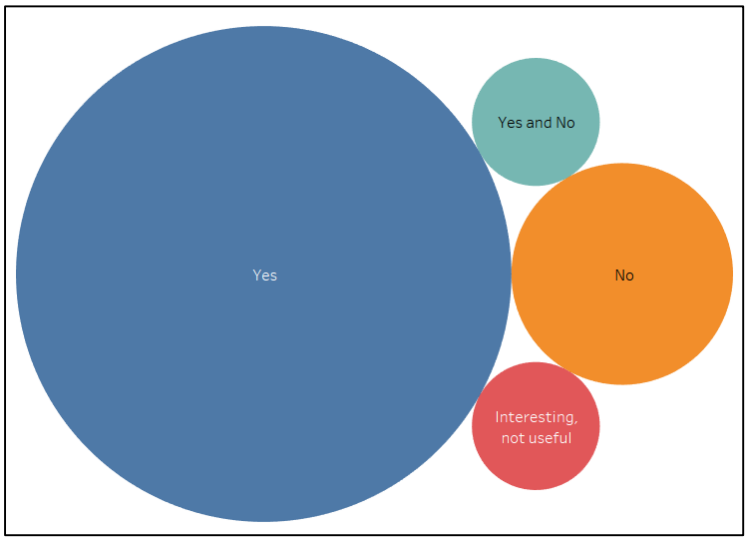

Figure 5.9. Beneficial and interest to monitor appliances.

There were some people who expressed worries about the security. "…every system is vulnerable to hacking, the only thing that could be useful is a monitoring system so that you know if the stove is on or not" (P11), even one person who said "Yes" talked about this fact "…it seems a little frightening, as these applications can be hacked by other people" (P06).

There was also one answer, saying that it would be "Interesting, yes. I don't feel like I would have very much use for it in my current life though." (P14).

In real life however, it doesn't seem like people use it. "Not really, in our building this is possible but I have not seen this widely used." (I01). I01 also believes that people don't find it beneficial and interesting to control and monitor their home appliances.

5.7 Perceived Risks

This section will analyse the answers that the Swedish and German residential participants gave that are connected to their perceived Risks. Each question will be analysed, comparing it to the different countries or different questions. This section will also analyse the answers given by Rikard Roth.

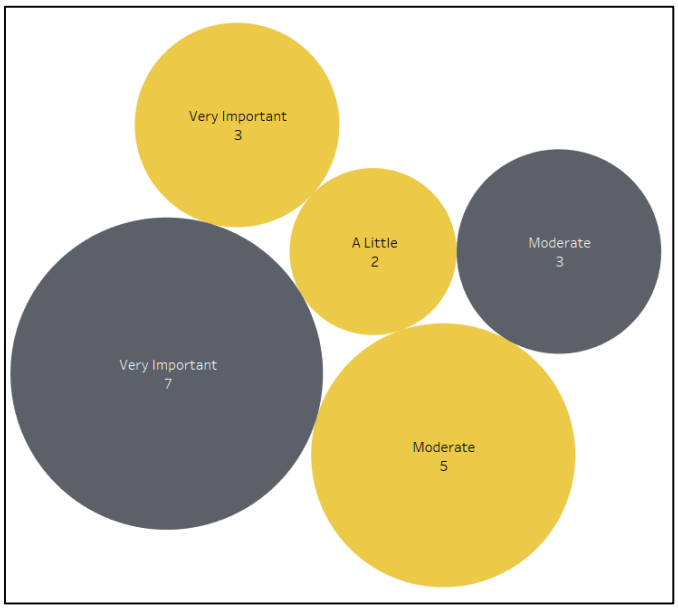

Figure 5.10. Importance of Privacy grouped by Country.

Do you describe yourself as a person who is keen to keep his/her privacy?

The circle graph (see Figure 5.10) shows that Germans (grey) believe that privacy is more important than what the Swedes (yellow) believe. 70% of Germans believe that it is very important while the remaining think that it is moderately important. The Swedish participants answered that only 30% believe that it is very important, while 50% believe that it is moderately important, and 20% percent believe that it is only a little important.

To what extent do you agree on disclosing your energy consumption information? Do any benefits affect your decision? Or other reasons?

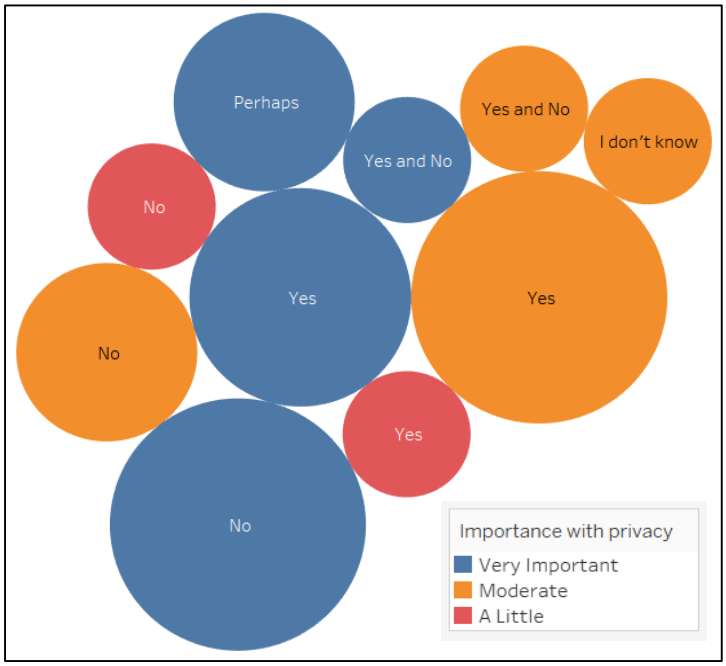

Figure 5.11. Disclose Energy Consumption Information grouped by Importance of Privacy

The circle graph (see Figure 5.11) shows that if people answered that it is "Very Important" (blue) with privacy there is a bigger chance that you will not want to disclose your information. Although if you have answered that it is moderately important with privacy you would like to disclose your information.

The next circle graph (see Figure 5.12) shows that Swedish people (yellow) are more open to disclosing their information that Germans (grey) are since 20% of Swedes answered that they wouldn't disclose it and 50% of Germans said that they wouldn't disclose their information.

The people who answered that they would disclose their energy consumption information had reasons like the fact that benefits in the way or rewards would affect the decision (P01), "I would gladly share data in order to make the society eco-friendlier and efficient." (P14), and "…as long as the process does not require me to manually send in data." (P15).

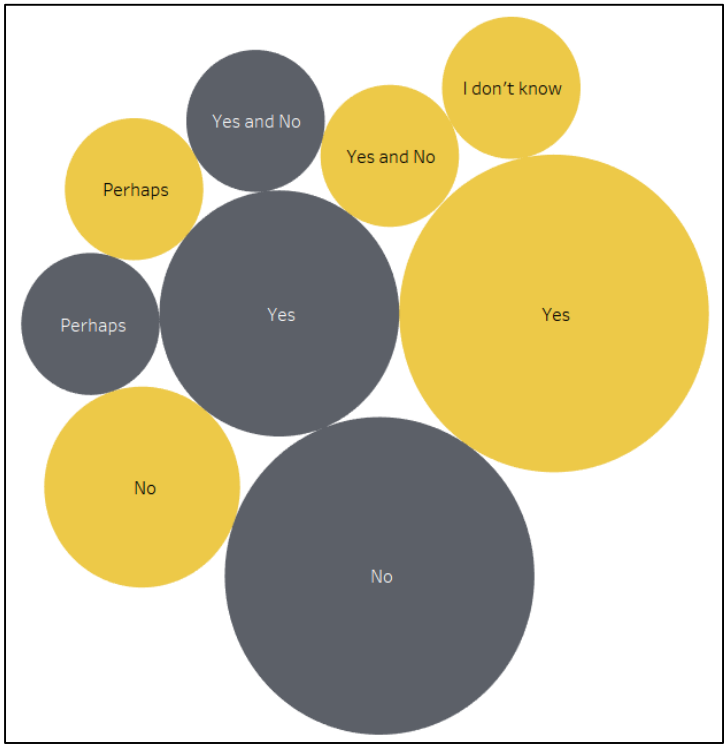

Figure 5.12. Disclosing Energy Consumption Information grouped by Country.

There are also some people with security conditions. "Excluding time schedules, when I am at home, alone or with somebody - all these data need to be handled with high care." (P05), "to the level of the privacy agreement" (P10), and "What if the companies got hacked and the information got leaked? Easy target for burglars or other criminals." (P20).

There are some worries and not enough benefits. "I think it is some extend problematic to give all the data away, even if it is said, that all date will be used securely. I do not see any benefits for me so far." (P02), and "the disadvantages would outweigh the benefits as I wouldn't want other people to know what exactly I'm doing and when I'm doing it. I could only imagine an app like this if it would be only for my private use." (P06).

I01 says that they do gather and save energy data from their customers. "Yes, due to billing purposes and a general interest in running the building efficiently." (I01).

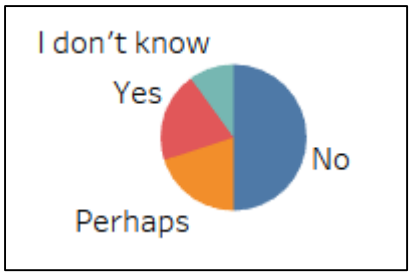

Figure 5.13. Trusting that Data won't be used outside of Analysing Energy Consumption Behaviour.

50% of the people answered that they don't trust that their information won't be used for other aims. While only 20% trusts that their information will only be used for analysing the energy consumption behaviour. Figure 5.9 shows this in a pie chart. "No" being blue and "Yes" being red.

The reasons why half of the participants answered that they wouldn't are mainly because of security and advertisement reasons. "I think it could be used for direct advertisement" (P06), "I always feel there is a marketing need behind my data" (P08), and "I am convinced data will be sold on without any concern for me" (P09). There are also people who think that advertisement isn't necessarily a bad thing. "It will probably be used for advertising, but that can also be a good thing." (P15).

There are also people who have conditions with protection, "it depends on how well it's protected" (P10), and security agreements "…if there's a security agreement" (P12).

70% of the German participants and 40% of the Swedish participants answered that they would not trust energy providing companies and vendors with their data. Figure 5.10 shows the participants answers grouped by country. Germany being grey and Sweden being yellow. Again there was a security concern (P01 and P18) and a wish for a contract (P19), although there were also some new ideas. P04 would trust companies with private data if there was some control from the state and P10 says that it depends on their reputation and legal responsibilities.

I01 answered on whether the data is used only for the customer's usage, their usage, or if it is used for any third parties, that they use it mostly for their own purposes. "mostly our own. E.ON sometimes also studies the data and external persons doing thesis have looked at some data." (I01). I01 also answered that they don't do anything special for people to trust them.

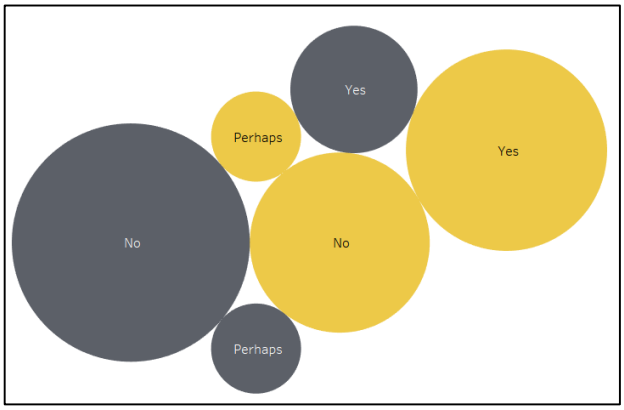

Figure 5.14. Trusting Companies with Private Data grouped by Country.

Chapter 6. Discussion

In the course of the previous section, we listed and analysed the empirical findings based on their country. In this section, we are going to discuss the findings against the literature review and research model. Our discussion will also focus on checking whether there is any significant difference in the attitude towards using a new technology between German and Sweden.

6.1 Participant Characteristics

As defined earlier, personality was described as the stable relationship with internal and external stimulants (Özbek et al., 2014). The Participants from both Germany and Sweden showed various personal traits and characteristics which we will discuss against the litterateur review and research model.

- *Knowledge and Environmental awareness*

From all the 20 participants, 90% are tech literate, which indicates the minimum knowledge to use a tech device. Knowledge is believed to directly affect one's decision and behaviour (Ackerman, 1996). Thus, positive knowledge is a good indicator that we are gathering information from a reliable sample.

Nevertheless, one of the major problem about knowledge and consumption awareness is the missing information in which residents do not comprehend the consequences of their daily actions. For instance, most residents do not know what occurs if they increase their energy consumption, heating consumption and even home recycling (de T'Serclaes, 2007).

Moreover, the environmental sense and awareness also reported a 90% positive responses in both Germany and Sweden. The high level of knowledge we can interpret in our participants through the tech literacy, can give us a good explanation on their high environmental awareness as well. (Grubb et al., 2009), (Baddeley, 2011) and (McNamara and Grubb, 2011) findings can also be verified through our findings, the relation between knowledge and environmental awareness is very tight. In which we assume, if the participant's tech literacy was low, the environmental awareness would have been expected also to be low.

- *Personal Privacy*

Personal privacy in Germany happened to be a much more sensitive issue than it is in Sweden, and this is based on the 20 responses we got on Q12. The German participants are obviously more keen to keep their privacy than the Swedish ones. Here we would like to emphasize that Sweden ranking 4th while Germany ranks 6th in accessibility of open data (Index, 2014) can explain our findings. Yet, that also explains why privacy concerns and perceptions differ widely across nations and cultures (Mason and Culnan, 1995) and (Nowak and Phelps, 1992).

6.2 Social Factors

Individuals are often incentivised by money to value their social worth through individual contribution (Frey and Oberholzer-Gee, 1997) however one's attitudes towards change is believed to be affected by the variation of (1) age, (2) gender, (3) knowledge, (4) socio-economic status, and (5) culture (Baddeley, 2011).

Environmental awareness is believed to be often affected to social and political views (Costa and Kahn, 2013), in which social and cultural differences can lead to different responses and point of view. Relating to our research, we will discuss the social factors that directly impact the decision of the user to adopt a EIS. The discussion below is done on the country level, to asses and interpret the social and cultural differences, and their effect on other constructs based on our research model.

German participants showed a moderate tendency to seek advice prior to using a new tech, while the Swedish participants reflected a high tendency. However, both showed a moderate affection by social pressure. Resulting in an understanding that the variation between both countries can be due to the difference in culture (Baddeley, 2011) or it may be other interrelated means that affect the behaviour of a single individual towards using and accepting a new technology (Thompson et al. 1991). However, there is also another understanding based on social cognition definition by Bandura (1989) in which individual's function as contributors to their own motivation. The feeling of contributing can be higher in Germany than it is in Sweden, however with the current findings, we cannot assume. This topic has room for future research.

6.3 Perceived Usefulness

Although there is a not much difference in the level of social pressure between Germany and Sweden, still 90% of the participants from both countries responded that they would make an actual use out of the system. This in fact contradicts with the findings and actual experience of (Fastigheter, 2013), since their "experience is that they do not use it as much as we hoped. It is connected to the cost savings that is possible. Energy is not costly in Sweden today." Yet, we saw an initial acceptance of the majority, that they would make use out of an EIS and they believe that it is good for the environment.

The majority were positive about using and accepting an EIS in their houses, however we have got a minority who had some concerns like price, information security, maintenance, and environment. Price factors with no doubt impacts one's behaviour towards accepting and using a given technology (Hassett, 1995). P20, P04, P12 and P06 raised concerns about the price of the EIS as a condition for accepting such a solution. On the other hand, P15 was keen to know how much reliable is the system, and whether it is high or low maintenance. Moreover, information and personal privacy concerns were raised by P16, and environmental concerns were agreed upon by 90% of our participants. Which indicates a high anticipation for a positive usefulness.

The personal traits and social factors and most important the privacy perception variations, may have been a heavy impact on perceived usefulness in other studies, however as per what we have interpreted in the empirical findings, the coronation is low, in which the useful-

ness of an EIS is positively anticipated. However, we have to point here that Rikard Roth mentioned that “only if there is a money incentive that is big enough” in terms of saving or rewards, is when consumers start using the system and reducing their energy consumption.

6.4 Perceived Ease of Use

This section will discuss the answers that the Swedish and German residential informants gave that are connected to their perceived Ease of Use. Each question will be discussed, comparing it to the different countries or different questions. This section will also discuss and compare the answers given by Rikard Roth and the residential informants.

People seem to think that using an application on a phone or tablet is easy regardless of their age, gender, or origin. Which let’s us assume that applications have become such a big part of normal day life that it is seamingly easy to use it, which is good news for a product or service that are basing its customer relationship and experience on an application. Although since one person, P17, states that he “..prefer viewing it on a real computer” it shows that it is important to also have the option to use the EIS through a computer and not only as an application.

I01 answered that can be done in this area and that GUI needs to be developed further, when talking about their own application. This shows that companies see the need and that this is something important in order for an application to be easy to use.

Since everyone answered “No” on this question it is very positive since it means that there might not be a huge cost of teaching the application to the users when implementing it in their home. It also shows how used people are to new applications. Therefore there is an importance of making an application that is similar to the ones that they are used to, following simple application guidelines.

However, our informant believes that people do need help when using a new application and they offer videos and brochures, as well as showing the system to the users numerous times (I01). This could eirther be because the system is too complex for people to understand simply by looking at the application or it could be because their GUI isn’t as good as it could be, which they said in the previous question.

Since 90% of the German informants believed that only the adults should be using the EIS it shows that the German informant's want to keep control of the electronics in the household. The reasons behind this could be many, perhaps for security resons, which will be discussed in a later section.

40% of the Swedish informants believe that the EIS should be used by all family members, which shows that Swedish people believe that it is easy enough for a child to use an application while it also shows that Swedes trust the application enough to let their kids use it. Or perhaps they simly trust their kids enough. The women in Sweden are 50/50 about allowing everyone to use it while 66.6% of the men believe that only the adults should be using the EIS.

6.5 Perceived Benefits

This section will discuss the answers that the Swedish and German residential informants gave that are connected to their perceived Benefits. Each question will be discussed, comparing it to the different countries or different questions. This section will also discuss and compare the answers given by Rikard Roth and the residential informants.

With 70% answering that companies will gain a better understanding while 20% saying that they don't know shows that companies should emphasise the positive outcomes of having an EIS more. There is allot of personal gain but also the company gains from it. If people believe that companies will understand more about consumption, there is also a possibility that people think that companies might track specific activity. Also, I01 answered that gathering energy consumption data help to understand the trends.

An EIS can help energy consumers understand and manage the energy through an consumption display (Wood and Newborough, 2007), and since 90% of the people answered “Yes” it shows that see one of the benefits with an EIS clearly. Jarrah et al. (2015) also said that an EIS would reduce the power loss, vanish peak hours and give effective power management. It also shows, when looking at the data, that there is no difference between the two countries when it comes to the fact that EIS could help in reducing energy.

The people answering “Yes” pay on average 144,4 kr more per month than the people answering “No”. This shows that there isn't a huge difference depending on how much people pay for their energy and if they feel that EIS would help in reducing their energy consumption. Although since the people answering “Yes” do pay more they might have done more thinking about how they could reduce their electricity costs than the people answering “No”.

Since there is only a 0,1 person more living in a household that answered “Yes” it shows that the amount of people living in the residence is unattached to if they think that EIS would help in reducing their energy consumption.

The people answering “No” have on average a 311,9 m2 larger house that the people answering “Yes”. This shows that the people who have smaller residents feel that an EIS would have a larger impact on their energy consumption than the people with a larger residence.

These statistics are interesting since the people who answered “Yes” pay more for their electricity and have a smaller residence. This might be because the people with larger residents already do other things to reduce their electricity, or simply that there wasn’t enough data. Only two people answered “No”, which makes it hard to generalise. It also shows that the people answering “Yes” wish to reduce their consumption in order to save money. This corresponds with what I01 says since he believes that an EIS can reduce the energy consumption and that there is a need for a money incentive in order to reduce the consumption.

I01’s last comment saying that people will start caring more about using less energy since energy will become more expensive shows that this is a big incentive that the EIS providers and the consumers want and in the future will need.

There are many benefits with an EIS, which the participants expressed as interesting. It can help people to understand and manage the energy through a display (Wood and Newborough, 2007). This display acts like an informative interface to inform the users on their energy consumption patterns, and while the majority, 75%, thought it to be beneficial and interesting because of energy saved and the broader possibilities given by it through remote control, there

were others who expressed security concerns. “In some ways it’s beneficial, as it makes a lot of things easier, you have a better overview over everything, but at the same time it seems a little frightening, as these applications can be hacked by other people” (P6). Since people answering “Yes” even had this concern it is something of great importance which the companies and vendors have to take into account, making their customers feel as safe as possible.

It is interesting that I01 thinks that people don’t use the EIS as much as it was thought out from the beginning. This could be because the GUI isn’t at its best, which was mentioned before, or because people imagine that they will use something but then when it comes down to it they don’t since this takes too much time out of their everyday life. This shows how important it is with a good GUI and a good analysis of the people who will use it before an EIS is implemented in the house. Since people might not find it interesting and beneficial to monitor their home appliances in I01’s residents perhaps they did not do any type of screening of who gets to live there and use the EIS. A display is also meant to motivate consumers to live more energy efficient (Fastigheter, 2013b), which is why it is important to have a GUI and a display that the user enjoys using.

6.6 Perceived Risks

This section will discuss the answers that the Swedish and German residential informants gave that are connected to their perceived Risks. Each question will be discussed, comparing it to the different countries or different questions. This section will also discuss and compare the answers given by Rikard Roth and the residential informants.

Since Germans believe that it is more important with privacy compared to the Swedes there is a need to take this into consideration when analysing if the application will be accepted or not. This was also mentioned in the earlier section, the fact that privacy is of importance, although not it is also clear that this could depend on the culture and origin. One application and agreement might work will in one country while in another it will seem loose and risky. Most information systems fail because of lower user acceptance (Torkzadeh and Angulo, 1992), and one of the main points for user acceptance is that the system is trusted by the users.

Since 20% of Swedes and 50% of Germans said that they wouldn't disclose their information it shows that Germans are more worried about disclosing their information to companies. One of the main reasons why people wouldn’t want to disclose their energy consumption information is security. They do not trust the companies to keep their information safe and they do not want companies to have access to information telling them about themselves and their habits. If the company wanting people to disclose their information has a way in which people wouldn’t feel like their information was in risk this would be something to advertise. I01 mentioned that they need to gather the data for billing purposes and for running the business efficiently. It is also important to manage the energy consumption and gather energy consumption data, in order to improve energy efficiency, which can be done through the implementation of smart grids (Palma-Behnke R. et al., 2013).

Since the participants explained their worries about advertisement and their wish for security agreements it shows that it is important to have clear understanding and agreements to make sure that people feel that they can trust the company that they share their information with. Only 20% said that they would trust their data in the hands of a company, while half of those had conditions for doing so. I01’s answer shows that only they see the data and if there have

been some studies of the data they have also seen it. Although not for any advertisement purposes. But since I01 also said that they don't do anything special for people to trust them it shows that perhaps they should in order for people to feel safe using it more and in order to get new customers. Since this is a big problem according to many of the participants.

This shows yet again that the German participants trust companies less easy compared to the Swedish participants. Although it also shows that there is some trust in the state.

6.7 Revisited Research Model

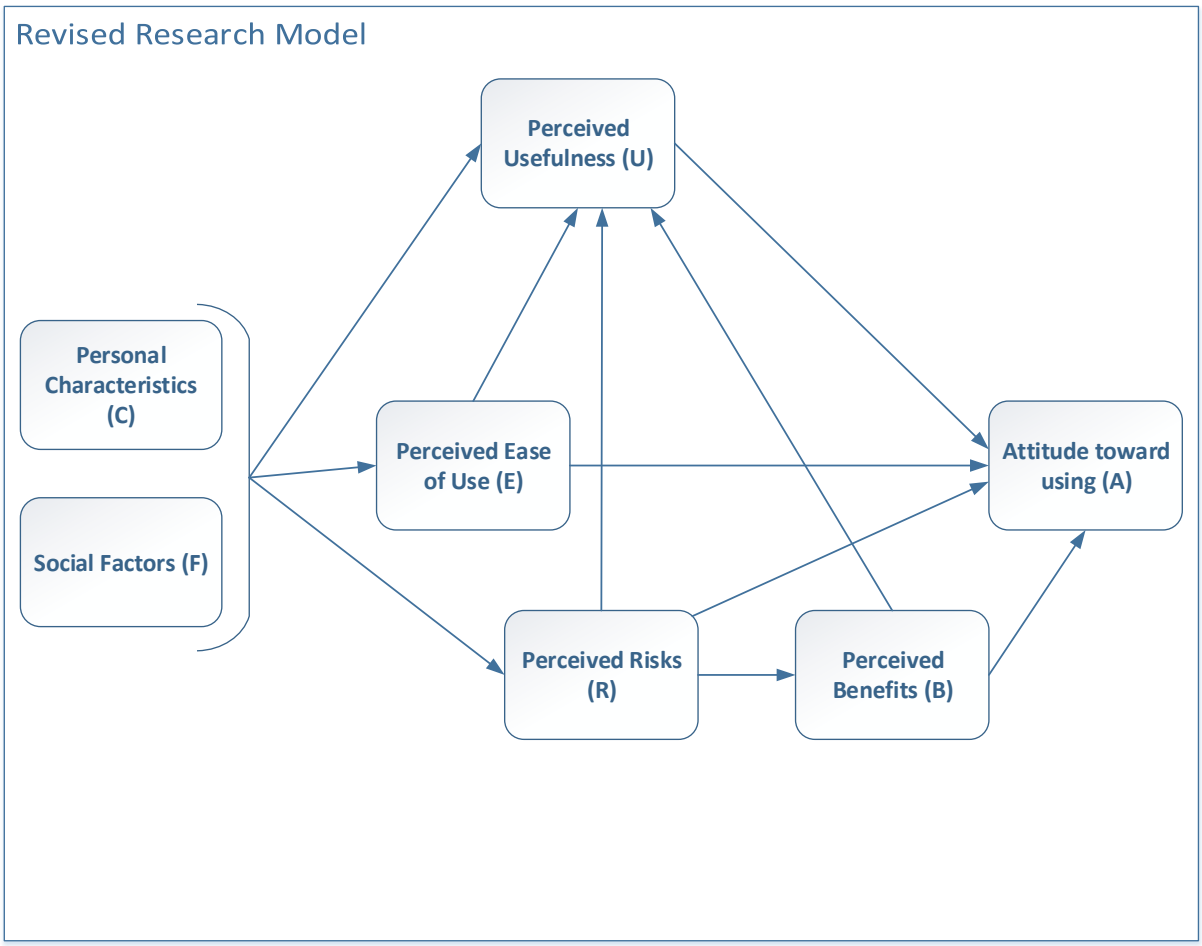

Table 6.1 Revised Research Model

Figure 4.1. demonstrated the initial research model. After listing our empirical findings, analysing and discussing them. We revisited our research model based on our analysis and findings. Figure 6.1 shows an additional two connections that we came to figure out based on the outcome of our discussion. Perceived Risks and Perceived Benefits, directly impact the Perceived usefulness of a Residential Energy Information System.

Chapter 7. Conclusion

7.1 Summary

Constructs		Findings		
		Germany	Sweden	Rikard Roth
External Variables	**Social Factors**	• Moderate tendency seeking advice prior to using a new tech. • Moderate affection by social pressure	• High tendency seeking advice prior to using a new tech. • Moderate affection by social pressure	• Users may be moderately affected by social pressure when using a new tech.
	Participant Characteristics	• 90% are Tech literate • Very keen to keep their personal privacy. • 90% Environmental Awareness. • 30% has a kind of an EIS implemented at their house.	• 90% are Tech literate • Moderately keen to keep their personal privacy. • 90% Environmental Awareness. • 30% has a kind of an EIS implemented at their house.	• Interest in technology and cost reduction can be the main drive for people to implement and use an EIS
Perceived Usefulness		• Mostly positive towards using an EIS in their households. • Concerns about Information Privacy and Cost.	• Mostly positive towards using an EIS in their households. • Concerns about the Cost of an EIS, Efficiency and Maintenance	• Low energy cost in Sweden, so the users don't really make good use out of an EIS. • Money incentive can be used to enhance Perceived usefulness • An EIS is a feasible and useful idea to reduce energy consumption.
Perceived Ease of use		• The Majority of the participants finds it easy to use a tech device. • The majority do not need much training to use a new tech device. • Majority would prefer only adults to use an EIS at their household	• The Majority of the participants finds it easy to use a tech device. • The majority do not need much training to use a new tech device. • Adults and Family members can use the EIS.	• For the application to be more easy, a better GUI should be in place. • Training is essential towards making an EIS easy to use. •
Perceived Benefits		• Majority believe that sharing their information may help the energy providers to better understand energy consumption patterns. • 70% believe that they can use an EIS to reduce energy consumption and reduce bills. • 75% believe that there is direct benefit from monitoring and controlling their appliances.		• Yes, gathering energy consumption data help to better understand the energy consumption trends and behaviour in residential sector. • People don't find it beneficial and interesting to control and monitor their home appliances
Perceived Risks		• 50% won't disclose their information to the energy providers. • High concern on information security. • Price and cost concerns. • Low trust in companies.	• 20% won't disclose their information to the energy providers. • Moderate concern on information security. • Price and cost concerns. • High trust in companies	• Users not using the system as intended to. • Mostly, the data collected is used by Roth Fastigheter and sometimes analysed by E.ON

Table 7.1 Conclusion summary table

The personal characteristics of the people from Germany and Sweden happens to be very different based on the sample of participants in this research. Privacy was the main variation between both countries, where personal information Privacy importance happens to be much higher in Germany than Sweden. The impact of personal traits may have had a very strong effect on the perceived usefulness and ease of use in other studies like (Thongpapanl et al., 2016); (Bonn et al., 2016), and (Thongpapanl et al., 2016). However, our findings indicated that there is minimal impact of the participant characteristics on the believe that an energy information system implementation within a household is useful and easy to use on both economic and environmental scales. Yet, people tend to find a new tech more useful if they expected money incentives or they have an interest in technology (I01). Thus we can conclude that the connection between the external variables and perceived usefulness and ease of use, is partially true in which there is a weak connection between the participant characteristics, on one side, and perceived usefulness and perceived ease of use for a residential energy information system on the other.

Risks on the other side, were affected by both social factors and personal traits. Germans high concern on information privacy reflected on the perceived risks of the REIS in which 50% of them refused to disclose information to companies while only 20% of the swedes refused. This confirms a strong relation between the external variables and perceived risks (see table 6.2) in which risks are impacted directly by personal traits and social factors.

Moreover, after studying the social factors in both Germany and Sweden, through our participant's responses. We came to conclude that Germans have a lower tendency to ask for advice prior to using a new tech than Swedes. Yet, both countries showed a moderate affection by social pressure whenever they want to decide on using a new technology. And so that was I01 believe. However, this slight difference did not heavily impact the perceived usefulness and ease of use of REIS, where we have got 90% positive replies on the REIS perceived usefulness and an average of 60% who believed that an EIS can be easy to use. Thus we can settle that the relation between the external variables and the perceived ease of use (see table 6.2) is partially consistent in our research, although the case in other research resulted differently (Kulviwat et al., 2007); (Bandura, 1986); (Compeau and Higgins, 1995); (Venkatesh et al., 2012) and (Thompson et al. 1991).

Although participants from both Germany and Sweden had a positive response towards the perceived usefulness of an EIS, however their concern varied somehow. Germans main concern was information Privacy, and the cost. The Germans major perceived risk towards using an EIS was information privacy where 50% won't disclose their information to the energy providers. While Sweden's main concern was the reliability and the cost with only 20% refusing to disclose their information. However, we learned that in practice, the people are not using the implemented system as intended due to other reasons like the user interface and the design of the solution. However, usefulness can be increased by money incentives (I01). Although the perceived interaction usefulness may not be as expected, however the environmental benefits are high (I01). The Ease of use of the EIS also plays as a very important factor, allowing the user to make the intended use out of the system. This can be enhanced by building advance GUI (I01). Adding, 70% of participants from both countries, believe that they can use an EIS to reduce energy consumption and reduce bills. And 75% believe that there is direct benefit from monitoring and controlling their appliances. This reflected positively on the perceived usefulness and Perceived ease of use. Thus, we conclude that perceived usefulness is directly impacted by perceived risks, benefits and ease of use (see table 6.2).

The vast majority of the participants believes that sharing their information with energy providers would enhance energy efficiency and help the companies study and analyse consumption patterns. However, Germans trust companies less than Swedes do resulting in a higher perceived risk in using an REIS. This impact explains the connection between perceived risks and benefits (see table 6.2).

As per our research model which is originally adopted from (Davis, 1989), the attitude towards using a new technology is affected by perceived usefulness, perceived ease of use, perceived risks and perceived benefits. After going through the 4 contracts, and evaluating the answers of our participants in both Germany and Sweden and our informant. We can conclude, the attitude toward using an REIS is higher in Sweden than it is in Germany. The reasons we stated before on information security, the acceptance to disclose personal information, Cost sensitivity and the tight relation of perceived risks and the perceived benefits all played a role in concluding this variation. Hence, we can say that the attitude towards using a REIS is impacted by usefulness, ease of use, risks and benefits as demonstrated in our revisited research model in figure 6.1.

Finally, in the course of writing this paper, we came to identify some areas where there is high potential and room to do future research and studies. The section below will briefly discuss the future research possibilities of residential energy information system.

7.2 Future Research

There is potential of more research being done in the field of EIS, of technology acceptance, and of different cultures and their views on information systems. I01 mentioned that there is a need of a better GUI and since a good display can help motivate the energy consumers to live more energy efficiently (Fastigheter, 2013b), and in that way save more money. There can therefore be more research on what kind of GUI makes people more motivated and want to use an application. Much of the GUI design research is outdated and there is a need for research looking at displays that are interactive and follow people around without being in the way.

There could also be more research done on information security. Many of the participants were worried about security and privacy issues, sometimes it was even a reason not to use a system. There therefore needs to be more research on what kind of security would make people safe, and also how the information could be more safe.

Since we realised that there was a difference between the two cultures that we studied we also realised that there is a need of more research done in the information technology and information system field through studying culture. This could direct companies to specific countries where the technology acceptance is higher and also if they want to expand to countries where the technology acceptance isn’t as high, what precautions they should take and also what that culture would need in order to trust and accept a new technology.

7.3 Acknowledgments

We would like to thank the 20 participants, specifically 10 participants from Germany and 10 participants from Sweden, who took part of our research by agreeing to sit for an interview which took around 20 min each. We would like to also thank our informant Rikard Roth the CEO of Roth Fastigheter for his valuable time and contribution to this research paper. And last but not least, we would like to thank our families, friends and all who supported us in accomplishing this research paper.

Appendix 1- Interview Question Key.

Code	Question
Q01	How old are you?
Q02	In which country are you living?
Q03	Gender?
Q04	Are you a fan of technology?
Q05	Do you own or rent your own household / apartment?
Q06	What's the area of your residence in square meters?
Q07	How many people are living in the resident? Please enter a number.
Q08	On average, how much do you pay every month on Energy Consumption including cooling and heating?
Q09	Do you have any kind of energy management or energy monitoring systems installed at your property?
Q10	Do you care for the environment or environmental issues? example: Global warming, Pollution etc...
Q11	Do you think that an increased energy consumption at households is bad for the environment?
Q12	Do you describe yourself as a person who is keen to keep his/her privacy?
Q13	Do you think that you would make use of an energy system that allows you to reduce your energy consumption?
Q14	Do you think it is a feasible idea to implement Residential EIS in households which can help you reduce your energy consumption?
Q15	Is energy consumption an environmental problem?
Q16	Do you find it easy to use an application on your mobile or tablet?
Q17	Do you often need help or training using a new application?
Q18	Will you find it beneficial and interesting to control and monitor your major home appliances such as cooling, heating, lights, shutters, etc..) remotely? And why?
Q19	If you would have an EIS implemented in your household, who would be using it?
Q20	Do you think that implementing an EIS, which gives you control to the house energy, can help in reducing your consumption?
Q21	Do you think that sharing your energy consumption data with the companies and vendor will help them better understand the energy consumption trends and behavior in residential sector?
Q22	To what extent do you agree on disclosing your energy consumption information? Do any benefits affect your decision? Or other reasons?
Q23	Do you trust that your data won't be used for any other aims rather than analyzing the energy consumption behavior?
Q24	Do you think you can trust the energy providing companies and vendors with your data?
Q25	Why do you usually use a new technology? Is it because the majority are using it or you do your own research?
Q26	In general, to what extent do you think you are affected by what you hear from the people around you?
Q27	In general, do you seek advice from friends before buying a new tech device, software or solution?

Q28	Do you think it is a cool thing to have an energy consumption house tracker that you can access from your phone or tablet?
Q29	Finally, would you like to add anything to what you have answered?

Appendix 2 - Interview Guide for Informant

The Informant Rikard Roth, the CEO of Roth Fastigheter agreed to take part of our research and went through an interview with the below questions and responses.

Consent Form

Residential energy information systems acceptance interview- Consent Form

Ebba Gullstrand & Hussein Haitham

Lund University, School of Economics and Management, Department of informatics

gif15hha@student.lu.se, sys12egu@student.lu.se

+46 72 579 09 32

You are invited to take part in a research study of Residential Information Systems

What the study is about: The study is about end user's technology acceptance of Residential EIS, Energy Information Systems.

What you will be asked to do: The participants will answer questions related to energy consumption, technology use and some other information through interviewing while we will be taking notes which will be used for analysis in the study. The questionnaire will take between 15 to 20 min to complete.

Participation: Taking part in this study is completely voluntary. If you choose to be in the study you can withdraw at any time without consequences of any kind. All the information you participate with will be totally anonymous. Participating in this study does not mean that you are giving up any of your legal rights.

Risks and benefits: There are no anticipated risks to you if you participate in this study, beyond those encountered in everyday life. The participant will contribute to the research as well as the Information Systems field.

your identity will be confidential.: The records of this study will be used to analyse and report a general view of Energy Information Systems technology acceptance. The data will be analysed and reported and any conclusions of this research that is made available to the public will not include your name or any other individual information by which you could be identified.

If you have questions or want a copy or summary of the study results:
Contact the researcher at the email address or phone number above. You will be given a copy of this form to keep for your records.

Statement of Consent:

I have read the above information, and have received answers to any questions. I affirm that I am 18 years of age or older. I consent to take part in the research study of Residential Energy Information Systems Technology Acceptance Survey.

_____ _____

Code	Question	Responses
	Date	2016-08-15 09
Exp01	Do you believe that people can make use of an energy system that allows them to reduce their energy consumption? Why?	Yes, visibility to what you are using in energy resources will for most people mean something.
Exp02	Do you think it is a feasible idea to implement Residential EIS in households which can help reduce your energy consumption? Why?	Yes
Exp03	Is energy consumption an environmental problem? Why?	Most of energy sources are not renewable, hence pollutes the environment.
Exp04	Do you believe people find it easy to use the application? Why?	More to do in this area. GUI needs to be developed further.
Exp05	Do you believe people need help or training to use the application? If yes, do you offer this?	yes, we have shown the system numerous times and also made videos and brochures.
Exp06	Do you believe people find it interesting and beneficial to control and monitor their major home appliances such as cooling, heating, lights, shutters, etc..) remotely? Why?	Not really.
Exp07	Do you believe people how have an EIS implemented in their home use it? If yes, why? If no, why?	Our experience is that they do not use it as much as we hoped. It is connected to the cost savings that is possible. Energy os not costly in Sweden today.
Exp08	Do you believe an EIS can reduce the energy consumption?	yes, but as mentioned only of there is a money incentive that is big enough.

Exp09	Does gathering energy consumption data help to better understand the energy consumption trends and behaviour in residential sector?	yes
Exp10	Do you gather and/or save energy data from your customers? Why?	yes, due to billing purposes and a general interest in running the building efficiently.
Exp11	Is the data used only for the customer's usage, your usage, or is it used for any third parties?	mostly our own. E.ON sometimes also studies the data and external persons doing thesis have looked at some data.
Exp12	What do you do in order for people to trust you with their data?	nothing specially
Exp13	Why do you believe people get new technology?	Because they are interested in technology and do their own research.
Exp14	In general, to what extent do you think people are affected by what they hear from the people around them?	Moderately affected
Exp15	Do you believe people seek advice from friends before buying a new tech device, software or solution? Why?	best advice comes from someone you know and trust.
Exp16	Do you think people believe it is cool to have an energy consumption house tracker that can be accessed from their phone or tablet? Why?	not really, In our building this is possible but I have not seen this widely used.
Exp17	Finally, would you like to add anything to what you have answered?	Doing these installations brings you a future safe building. Eventually energy will become more expensive and people will start to care more.

Appendix 3 – Interview questionnaire Responses

20 Participants took part of our research, the interview questions and responses are listed below. The 20 participants agreed on the below consent form prior to conducting the interview.

Consent Form

Residential energy information systems acceptance interview- Consent Form

Ebba Gullstrand & Hussein Haitham

Lund University, School of Economics and Management, Department of informatics

gif15hha@student.lu.se, sys12egu@student.lu.se

+46 72 579 09 32

You are invited to take part in a research study of Residential Information Systems

What the study is about: The study is about end user's technology acceptance of Residential EIS, Energy Information Systems.

What you will be asked to do: The participants will answer questions related to energy consumption, technology use and some other information through interviewing while we will be taking notes which will be used for analysis in the study. The questionnaire will take between 15 to 20 min to complete.

Participation: Taking part in this study is completely voluntary. If you choose to be in the study you can withdraw at any time without consequences of any kind. All the information you participate with will be totally anonymous. Participating in this study does not mean that you are giving up any of your legal rights.

Risks and benefits: There are no anticipated risks to you if you participate in this study, beyond those encountered in everyday life. The participant will contribute to the research as well as the Information Systems field.

your identity will be confidential.: The records of this study will be used to analyze and report a general view of Energy Information Systems technology acceptance. The data will be analyzed and reported and any conclusions of this research that is made available to the public will not include your name or any other individual information by which you could be identified.

If you have questions or want a copy or summary of the study results:
Contact the researcher at the email address or phone number above. You will be given a copy of this form to keep for your records.

Statement of Consent:

I have read the above information, and have received answers to any questions. I affirm that I am 18 years of age or older. I consent to take part in the research study of Residential Energy Information Systems Technology Acceptance Survey.

_____ _____

Participant's Signature Date

Q Code	Question	Participant 1
N/A	Date and Time	08/10/16 13:00
N/A	Initials	A.O.
N/A	Date	08/10/16
Q01	How old are you?	28
Q02	In which country are you living?	Germany
Q03	Gender?	Female
Q04	Are you a fan of technology?	Yes
Q05	Do you own or rent your own household / apartment?	No
Q06	What's the area of your residence in square meters?	100
Q07	How many people are living in the resident? Please enter a number.	3
Q08	On average, how much do you pay every month on Energy Consumption including cooling and heating?	
Q09	Do you have any kind of energy management or energy monitoring systems installed at your property?	No

Q10	Do you care for the environment or environmental issues? example: Global warming, Pollution etc...	Yes
Q11	Do you think that an increased energy consumption at households is bad for the environment?	Yes
Q12	Do you describe yourself as a person who is keen to keep his/her privacy?	Very Important
Q13	Do you think that you would make use of an energy system that allows you to reduce your energy consumption?	depending on how easy and how fun the system is to use.
Q14	Do you think it is a feasible idea to implement Residential EIS in households which can help you reduce your energy consumption?	yes, I think so
Q15	Is energy consumption an environmental problem?	depending on how the energy was generated: yes. I mean, there is green energy so that would be less of a problem then other forms of energy.
Q16	Do you find it easy to use an application on your mobile or tablet?	yes.
Q17	Do you often need help or training using a new application?	No
Q18	Will you find it beneficial and interesting to control and monitor your major home appliances such as cooling, heating, lights, shutters, etc..) remotely? And why?	maybe in the beginning it would be fun to switch the lights on and off via mobile devices. but i guess after a short time it becomes less interesting. turning the heating on remotely could be really useful though.
Q19	If you would have an EIS implemented in your household, who would be using it?	Adults
Q20	Do you think that implementing an EIS, which gives you control to the house energy, can help in reducing your consumption?	Yes
Q21	Do you think that sharing your energy consumption data with the companies and vendor will help them better understand the energy consumption trends and behavior in residential sector?	i am not sure.
Q22	To what extent do you agree on disclosing your energy consumption information? Do any benefits affect your decision? Or other reasons?	monetary rewards are always really powerful, so I guess those benefits would affect my decision.
Q23	Do you trust that your data won't be used for any other aims rather than analyzing the energy consumption behavior?	No, I generally don't trust big companies with those kind of information.

Q24	Do you think you can trust the energy providing companies and vendors with your data?	No, not really. There is always the risk of abuse or secondary use.
Q25	Why do you usually use a new technology? Is it because the majority are using it or you do your own research?	Do my own research before using any new technology
Q26	In general, to what extent do you think you are affected by what you hear from the people around you?	Highly affected
Q27	In general, do you seek advice from friends before buying a new tech device, software or solution?	Sometimes
Q28	Do you think it is a cool thing to have an energy consumption house tracker that you can access from your phone or tablet?	Maybe
Q29	Finally, would you like to add anything to what you have answered?	No.

Q Code	Question	Participant 2
N/A	Date and Time	08/10/16 14:00
N/A	Initials	L.S.
N/A	Date	08/10/16
Q01	How old are you?	24
Q02	In which country are you living?	Germany
Q03	Gender?	Male
Q04	Are you a fan of technology?	Yes
Q05	Do you own or rent your own household / apartment?	Yes
Q06	What's the area of your residence in square meters?	25
Q07	How many people are living in the resident? Please enter a number.	1
Q08	On average, how much do you pay every month on Energy Consumption including cooling and heating?	65€

Q09	Do you have any kind of energy management or energy monitoring systems installed at your property?	No
Q10	Do you care for the environment or environmental issues? example: Global warming, Pollution etc...	Yes
Q11	Do you think that an increased energy consumption at households is bad for the environment?	Yes
Q12	Do you describe yourself as a person who is keen to keep his/her privacy?	Very Important
Q13	Do you think that you would make use of an energy system that allows you to reduce your energy consumption?	yes
Q14	Do you think it is a feasible idea to implement Residential EIS in households which can help you reduce your energy consumption?	Yes
Q15	Is energy consumption an environmental problem?	yes
Q16	Do you find it easy to use an application on your mobile or tablet?	Yes
Q17	Do you often need help or training using a new application?	No
Q18	Will you find it beneficial and interesting to control and monitor your major home appliances such as cooling, heating, lights, shutters, etc..) remotely? And why?	Yes, I really would like to use it. It can be used even from outside of the home, in the case I forget something and it can be used when I am not in the room so that I can see whether in other rooms energy can be saved.
Q19	If you would have an EIS implemented in your household, who would be using it?	Adults
Q20	Do you think that implementing an EIS, which gives you control to the house energy, can help in reducing your consumption?	Yes
Q21	Do you think that sharing your energy consumption data with the companies and vendor will help them better understand the energy consumption trends and behavior in residential sector?	I think yes, but I also think it can cause some problems, as saving energy is not in the economic interest of companies.
Q22	To what extent do you agree on disclosing your energy consumption information? Do any benefits affect your decision? Or other reasons?	I think it is some extend problematic to give all the data away, even if it is said, that all date will be used securely. I do not see any benefits for me so far.

Q23	Do you trust that your data won't be used for any other aims rather than analyzing the energy consumption behavior?	No.
Q24	Do you think you can trust the energy providing companies and vendors with your data?	No.
Q25	Why do you usually use a new technology? Is it because the majority are using it or you do your own research?	Do my own research before using any new technology
Q26	In general, to what extent do you think you are affected by what you hear from the people around you?	Little affected
Q27	In general, do you seek advice from friends before buying a new tech device, software or solution?	Sometimes
Q28	Do you think it is a cool thing to have an energy consumption house tracker that you can access from your phone or tablet?	Maybe
Q29	Finally, would you like to add anything to what you have answered?	

Q Code	Question	Participant 3
N/A	Date and Time	08/10/16 14:15
N/A	Initials	C.G.
N/A	Date	08/10/16
Q01	How old are you?	54
Q02	In which country are you living?	Germany
Q03	Gender?	Male
Q04	Are you a fan of technology?	Yes
Q05	Do you own or rent your own household / apartment?	Yes
Q06	What's the area of your residence in square meters?	150
Q07	How many people are living in the resident? Please enter a number.	2

Q08	On average, how much do you pay every month on Energy Consumption including cooling and heating?	150
Q09	Do you have any kind of energy management or energy monitoring systems installed at your property?	Yes
Q10	Do you care for the environment or environmental issues? example: Global warming, Pollution etc...	Yes
Q11	Do you think that an increased energy consumption at households is bad for the environment?	Yes
Q12	Do you describe yourself as a person who is keen to keep his/her privacy?	Very Important
Q13	Do you think that you would make use of an energy system that allows you to reduce your energy consumption?	yes
Q14	Do you think it is a feasible idea to implement Residential EIS in households which can help you reduce your energy consumption?	yes
Q15	Is energy consumption an environmental problem?	yes
Q16	Do you find it easy to use an application on your mobile or tablet?	yes
Q17	Do you often need help or training using a new application?	No
Q18	Will you find it beneficial and interesting to control and monitor your major home appliances such as cooling, heating, lights, shutters, etc..) remotely? And why?	yes
Q19	If you would have an EIS implemented in your household, who would be using it?	Adults
Q20	Do you think that implementing an EIS, which gives you control to the house energy, can help in reducing your consumption?	Yes
Q21	Do you think that sharing your energy consumption data with the companies and vendor will help them better understand the energy consumption trends and behavior in residential sector?	yes

Q22	To what extent do you agree on disclosing your energy consumption information? Do any benefits affect your decision? Or other reasons?	Data should not be disclosed!
Q23	Do you trust that your data won't be used for any other aims rather than analyzing the energy consumption behavior?	If energy providers commit themselves - yes.
Q24	Do you think you can trust the energy providing companies and vendors with your data?	Yes - with control from state.
Q25	Why do you usually use a new technology? Is it because the majority are using it or you do your own research?	Majority are using it
Q26	In general, to what extent do you think you are affected by what you hear from the people around you?	Moderately affected
Q27	In general, do you seek advice from friends before buying a new tech device, software or solution?	Sometimes
Q28	Do you think it is a cool thing to have an energy consumption house tracker that you can access from your phone or tablet?	Yes

Q Code	Question	Participant 4
N/A	Date and Time	08/10/16 14:45
N/A	Initials	H.W
N/A	Date	08/10/16
Q01	How old are you?	27
Q02	In which country are you living?	Sweden
Q03	Gender?	Male
Q04	Are you a fan of technology?	Yes
Q05	Do you own or rent your own household / apartment?	Yes
Q06	What's the area of your residence in square meters?	60

Q07	How many people are living in the resident? Please enter a number.	1
Q08	On average, how much do you pay every month on Energy Consumption including cooling and heating?	200
Q09	Do you have any kind of energy management or energy monitoring systems installed at your property?	No
Q10	Do you care for the environment or environmental issues? example: Global warming, Pollution etc...	No
Q11	Do you think that an increased energy consumption at households is bad for the environment?	Yes
Q12	Do you describe yourself as a person who is keen to keep his/her privacy?	Moderate
Q13	Do you think that you would make use of an energy system that allows you to reduce your energy consumption?	Yes, depends on the price
Q14	Do you think it is a feasible idea to implement Residential EIS in households which can help you reduce your energy consumption?	yes
Q15	Is energy consumption an environmental problem?	yes
Q16	Do you find it easy to use an application on your mobile or tablet?	yes
Q17	Do you often need help or training using a new application?	No
Q18	Will you find it beneficial and interesting to control and monitor your major home appliances such as cooling, heating, lights, shutters, etc..) remotely? And why?	Yes, because it probably would save me money
Q19	If you would have an EIS implemented in your household, who would be using it?	Adults
Q20	Do you think that implementing an EIS, which gives you control to the house energy, can help in reducing your consumption?	Yes
Q21	Do you think that sharing your energy consumption data with the companies and vendor will help them	Maybe

	better understand the energy consumption trends and behavior in residential sector?	
Q22	To what extent do you agree on disclosing your energy consumption information? Do any benefits affect your decision? Or other reasons?	It should be fully disclosed; no benefits would affect my decision
Q23	Do you trust that your data won't be used for any other aims rather than analyzing the energy consumption behavior?	No
Q24	Do you think you can trust the energy providing companies and vendors with your data?	I trust that they will keep their end of the contract
Q25	Why do you usually use a new technology? Is it because the majority are using it or you do your own research?	Do my own research before using any new technology
Q26	In general, to what extent do you think you are affected by what you hear from the people around you?	Little affected
Q27	In general, do you seek advice from friends before buying a new tech device, software or solution?	Yes
Q28	Do you think it is a cool thing to have an energy consumption house tracker that you can access from your phone or tablet?	Yes
Q29	Finally, would you like to add anything to what you have answered?	No

Q Code	Question	Participant 5
N/A	Date and Time	08/10/16 14:55
N/A	Initials	F.G.
N/A	Date	08/10/16
Q01	How old are you?	29
Q02	In which country are you living?	Sweden
Q03	Gender?	Male
Q04	Are you a fan of technology?	Yes
Q05	Do you own or rent your own household / apartment?	Yes

Q06	What's the area of your residence in square meters?	55.5
Q07	How many people are living in the resident? Please enter a number.	2
Q08	On average, how much do you pay every month on Energy Consumption including cooling and heating?	80
Q09	Do you have any kind of energy management or energy monitoring systems installed at your property?	No
Q10	Do you care for the environment or environmental issues? example: Global warming, Pollution etc...	Yes
Q11	Do you think that an increased energy consumption at households is bad for the environment?	Yes
Q12	Do you describe yourself as a person who is keen to keep his/her privacy?	A Little
Q13	Do you think that you would make use of an energy system that allows you to reduce your energy consumption?	Perhaps
Q14	Do you think it is a feasible idea to implement Residential EIS in households which can help you reduce your energy consumption?	If it works, is cheap and non-invasive
Q15	Is energy consumption an environmental problem?	yes
Q16	Do you find it easy to use an application on your mobile or tablet?	yes
Q17	Do you often need help or training using a new application?	No
Q18	Will you find it beneficial and interesting to control and monitor your major home appliances such as cooling, heating, lights, shutters, etc..) remotely? And why?	no, every system is vulnerable to hacking, they only thing that could be useful is a monitoring system so that you know if the stove is on or not.
Q19	If you would have an EIS implemented in your household, who would be using it?	Adults
Q20	Do you think that implementing an EIS, which gives you control to the house energy, can help in reducing your consumption?	No

Q21	Do you think that sharing your energy consumption data with the companies and vendor will help them better understand the energy consumption trends and behavior in residential sector?	Perhaps, but I would not want to do that for free
Q22	To what extent do you agree on disclosing your energy consumption information? Do any benefits affect your decision? Or other reasons?	I do not want to for personal safety reasons
Q23	Do you trust that your data won't be used for any other aims rather than analyzing the energy consumption behavior?	no
Q24	Do you think you can trust the energy providing companies and vendors with your data?	absolutely not
Q25	Why do you usually use a new technology? Is it because the majority are using it or you do your own research?	Do my own research before using any new technology
Q26	In general, to what extent do you think you are affected by what you hear from the people around you?	Very little affected
Q27	In general, do you seek advice from friends before buying a new tech device, software or solution?	No
Q28	Do you think it is a cool thing to have an energy consumption house tracker that you can access from your phone or tablet?	Yes
Q29	Finally, would you like to add anything to what you have answered?	The question above is phrased as: "is it cool", my answer to that is: Yes. However, if the question would be asked "Would you want" my answer would be: No.

Q Code	Question	Participant 6
N/A	Date and Time	08/10/16 15:10
N/A	Initials	J.W.
N/A	Date	08/10/16
Q01	How old are you?	26
Q02	In which country are you living?	Sweden

Q03	Gender?	Male
Q04	Are you a fan of technology?	Yes
Q05	Do you own or rent your own household / apartment?	Yes
Q06	What's the area of your residence in square meters?	55
Q07	How many people are living in the resident? Please enter a number.	2
Q08	On average, how much do you pay every month on Energy Consumption including cooling and heating?	150
Q09	Do you have any kind of energy management or energy monitoring systems installed at your property?	No
Q10	Do you care for the environment or environmental issues? example: Global warming, Pollution etc...	Yes
Q11	Do you think that an increased energy consumption at households is bad for the environment?	Yes
Q12	Do you describe yourself as a person who is keen to keep his/her privacy?	Very Important
Q13	Do you think that you would make use of an energy system that allows you to reduce your energy consumption?	yes
Q14	Do you think it is a feasible idea to implement Residential EIS in households which can help you reduce your energy consumption?	Yes, if it's not too expensive
Q15	Is energy consumption an environmental problem?	yes
Q16	Do you find it easy to use an application on your mobile or tablet?	yes
Q17	Do you often need help or training using a new application?	No
Q18	Will you find it beneficial and interesting to control and monitor your major home appliances such as cooling, heating, lights, shutters, etc..) remotely? And why?	Yes, especially if I would be able to control everything from one single app.
Q19	If you would have an EIS implemented in your household, who would be using it?	All family members

Q20	Do you think that implementing an EIS, which gives you control to the house energy, can help in reducing your consumption?	Yes
Q21	Do you think that sharing your energy consumption data with the companies and vendor will help them better understand the energy consumption trends and behavior in residential sector?	yes, hopefully
Q22	To what extent do you agree on disclosing your energy consumption information? Do any benefits affect your decision? Or other reasons?	I'm not sure. Maybe only share my data from a short period of time. I wouldn't want anyone to always keep track of my consumption.
Q23	Do you trust that your data won't be used for any other aims rather than analyzing the energy consumption behavior?	You can never be 100% sure. But if there's a security agreement
Q24	Do you think you can trust the energy providing companies and vendors with your data?	You can never be 100% sure.
Q25	Why do you usually use a new technology? Is it because the majority are using it or you do your own research?	Do my own research before using any new technology
Q26	In general, to what extent do you think you are affected by what you hear from the people around you?	Moderately affected
Q27	In general, do you seek advice from friends before buying a new tech device, software or solution?	Sometimes
Q28	Do you think it is a cool thing to have an energy consumption house tracker that you can access from your phone or tablet?	Maybe
Q29	Finally, would you like to add anything to what you have answered?	

Q Code	**Question**	**Participant 7**
N/A	Date and Time	08/10/16 15:50
N/A	Initials	C.L.
N/A	Date	10/08/16

Q01	How old are you?	23
Q02	In which country are you living?	Sweden
Q03	Gender?	Female
Q04	Are you a fan of technology?	No
Q05	Do you own or rent your own household / apartment?	Yes
Q06	What's the area of your residence in square meters?	36
Q07	How many people are living in the resident? Please enter a number.	2
Q08	On average, how much do you pay every month on Energy Consumption including cooling and heating?	300
Q09	Do you have any kind of energy management or energy monitoring systems installed at your property?	No
Q10	Do you care for the environment or environmental issues? example: Global warming, Pollution etc...	Yes
Q11	Do you think that an increased energy consumption at households is bad for the environment?	Yes
Q12	Do you describe yourself as a person who is keen to keep his/her privacy?	Moderate
Q13	Do you think that you would make use of an energy system that allows you to reduce your energy consumption?	yes
Q14	Do you think it is a feasible idea to implement Residential EIS in households which can help you reduce your energy consumption?	yes
Q15	Is energy consumption an environmental problem?	yes
Q16	Do you find it easy to use an application on your mobile or tablet?	yes
Q17	Do you often need help or training using a new application?	No
Q18	Will you find it beneficial and interesting to control and monitor your major home appliances such as	yes!

	cooling, heating, lights, shutters, etc..) remotely? And why?	
Q19	If you would have an EIS implemented in your household, who would be using it?	Adults
Q20	Do you think that implementing an EIS, which gives you control to the house energy, can help in reducing your consumption?	Yes
Q21	Do you think that sharing your energy consumption data with the companies and vendor will help them better understand the energy consumption trends and behavior in residential sector?	yes
Q22	To what extent do you agree on disclosing your energy consumption information? Do any benefits affect your decision? Or other reasons?	not sure
Q23	Do you trust that your data won't be used for any other aims rather than analyzing the energy consumption behavior?	yes
Q24	Do you think you can trust the energy providing companies and vendors with your data?	yes
Q25	Why do you usually use a new technology? Is it because the majority are using it or you do your own research?	Majority are using it
Q26	In general, to what extent do you think you are affected by what you hear from the people around you?	Moderately affected
Q27	In general, do you seek advice from friends before buying a new tech device, software or solution?	Yes
Q28	Do you think it is a cool thing to have an energy consumption house tracker that you can access from your phone or tablet?	Yes
Q29	Finally, would you like to add anything to what you have answered?	

Q Code	**Question**	**Participant 8**

N/A	Date and Time	08/10/16 15:52
N/A	Initials	S.H.
N/A	Date	08/10/16
Q01	How old are you?	27
Q02	In which country are you living?	Sweden
Q03	Gender?	Female
Q04	Are you a fan of technology?	Yes
Q05	Do you own or rent your own household / apartment?	Yes
Q06	What's the area of your residence in square meters?	72
Q07	How many people are living in the resident? Please enter a number.	2
Q08	On average, how much do you pay every month on Energy Consumption including cooling and heating?	
Q09	Do you have any kind of energy management or energy monitoring systems installed at your property?	Yes
Q10	Do you care for the environment or environmental issues? example: Global warming, Pollution etc...	Yes
Q11	Do you think that an increased energy consumption at households is bad for the environment?	Yes
Q12	Do you describe yourself as a person who is keen to keep his/her privacy?	Moderate
Q13	Do you think that you would make use of an energy system that allows you to reduce your energy consumption?	Yes
Q14	Do you think it is a feasible idea to implement Residential EIS in households which can help you reduce your energy consumption?	Yes
Q15	Is energy consumption an environmental problem?	Yes
Q16	Do you find it easy to use an application on your mobile or tablet?	Mostly yes
Q17	Do you often need help or training using a new application?	No

Q18	Will you find it beneficial and interesting to control and monitor your major home appliances such as cooling, heating, lights, shutters, etc..) remotely? And why?	Yes. You will realise that there is a lot of unnecessary energy being wasted. And you can turn on certain appliances on your way home instead of having them turned on all the time.
Q19	If you would have an EIS implemented in your household, who would be using it?	Adults
Q20	Do you think that implementing an EIS, which gives you control to the house energy, can help in reducing your consumption?	Yes
Q21	Do you think that sharing your energy consumption data with the companies and vendor will help them better understand the energy consumption trends and behavior in residential sector?	Yes.
Q22	To what extent do you agree on disclosing your energy consumption information? Do any benefits affect your decision? Or other reasons?	It would probably Benefit me but I would not want all that information to be out there. What if the companies got hacked and The information got leaked? Easy target for burglars or other criminals.
Q23	Do you trust that your data won't be used for any other aims rather than analyzing the energy consumption behavior?	No
Q24	Do you think you can trust the energy providing companies and vendors with your data?	No
Q25	Why do you usually use a new technology? Is it because the majority are using it or you do your own research?	Majority are using it
Q26	In general, to what extent do you think you are affected by what you hear from the people around you?	Very Highly affected
Q27	In general, do you seek advice from friends before buying a new tech device, software or solution?	Yes
Q28	Do you think it is a cool thing to have an energy consumption house tracker that you can access from your phone or tablet?	Yes
Q29	Finally, would you like to add anything to what you have answered?	Datamining is scary as shit.

Q Code	Question	Participant 9
N/A	Date and Time	08/10/16 16:02
N/A	Initials	JGH
N/A	Date	08/10/16
Q01	How old are you?	32
Q02	In which country are you living?	Sweden
Q03	Gender?	Male
Q04	Are you a fan of technology?	Yes
Q05	Do you own or rent your own household / apartment?	Yes
Q06	What's the area of your residence in square meters?	32
Q07	How many people are living in the resident? Please enter a number.	1
Q08	On average, how much do you pay every month on Energy Consumption including cooling and heating?	400
Q09	Do you have any kind of energy management or energy monitoring systems installed at your property?	No
Q10	Do you care for the environment or environmental issues? example: Global warming, Pollution etc...	Yes
Q11	Do you think that an increased energy consumption at households is bad for the environment?	Yes
Q12	Do you describe yourself as a person who is keen to keep his/her privacy?	Very Important
Q13	Do you think that you would make use of an energy system that allows you to reduce your energy consumption?	Yes.
Q14	Do you think it is a feasible idea to implement Residential EIS in households which can help you reduce your energy consumption?	Yes.
Q15	Is energy consumption an environmental problem?	Yes. Very much so. The majority of the worlds electricity is still produced by burning coal.
Q16	Do you find it easy to use an application on your mobile or tablet?	Yes.

Q17	Do you often need help or training using a new application?	No
Q18	Will you find it beneficial and interesting to control and monitor your major home appliances such as cooling, heating, lights, shutters, etc..) remotely? And why?	Interesting, yes. I don't feel like I would have very much use for it in my current life though.
Q19	If you would have an EIS implemented in your household, who would be using it?	All family members
Q20	Do you think that implementing an EIS, which gives you control to the house energy, can help in reducing your consumption?	Yes
Q21	Do you think that sharing your energy consumption data with the companies and vendor will help them better understand the energy consumption trends and behavior in residential sector?	Yes, by having complete information about consumption a company could make the distribution more effective. By re-routing and filling storages in time before big surges for example. This would all require a more sophisticated system than our current ones though.
Q22	To what extent do you agree on disclosing your energy consumption information? Do any benefits affect your decision? Or other reasons?	I would gladly share data in order to make the society eco-friendlier and efficient. I really don't like the part about "sometimes third party vendors" - I interpret this as things like targeted marketing and adds.
Q23	Do you trust that your data won't be used for any other aims rather than analyzing the energy consumption behavior?	If it didn't I wouldn't sign up.
Q24	Do you think you can trust the energy providing companies and vendors with your data?	Yes
Q25	Why do you usually use a new technology? Is it because the majority are using it or you do your own research?	Majority are using it
Q26	In general, to what extent do you think you are affected by what you hear from the people around you?	Highly affected
Q27	In general, do you seek advice from friends before buying a new tech device, software or solution?	Yes
Q28	Do you think it is a cool thing to have an energy consumption house tracker that you can access from your phone or tablet?	Yes

Q29	Finally, would you like to add anything to what you have answered?	Aim to make a better world.

Q Code	**Question**	Participant 10
N/A	Date and Time	08/11/16 9:31
N/A	Initials	Js
N/A	Date	08/11/16
Q01	How old are you?	25
Q02	In which country are you living?	Sweden
Q03	Gender?	Male
Q04	Are you a fan of technology?	Yes
Q05	Do you own or rent your own household / apartment?	Yes
Q06	What's the area of your residence in square meters?	27
Q07	How many people are living in the resident? Please enter a number.	1
Q08	On average, how much do you pay every month on Energy Consumption including cooling and heating?	200
Q09	Do you have any kind of energy management or energy monitoring systems installed at your property?	No
Q10	Do you care for the environment or environmental issues? example: Global warming, Pollution etc...	Yes
Q11	Do you think that an increased energy consumption at households is bad for the environment?	No
Q12	Do you describe yourself as a person who is keen to keep his/her privacy?	Moderate
Q13	Do you think that you would make use of an energy system that allows you to reduce your energy consumption?	If it was low maintenance

Q14	Do you think it is a feasible idea to implement Residential EIS in households which can help you reduce your energy consumption?	It it a little unrealistic to anticipate cooperation on such a large scale
Q15	Is energy consumption an environmental problem?	Not at all
Q16	Do you find it easy to use an application on your mobile or tablet?	Yes
Q17	Do you often need help or training using a new application?	No
Q18	Will you find it beneficial and interesting to control and monitor your major home appliances such as cooling, heating, lights, shutters, etc..) remotely? And why?	Probably not, mostly because I have such a small apartment I lived in a house, however, it would probably interest me for the fun aspect of it.
Q19	If you would have an EIS implemented in your household, who would be using it?	Adults
Q20	Do you think that implementing an EIS, which gives you control to the house energy, can help in reducing your consumption?	Yes
Q21	Do you think that sharing your energy consumption data with the companies and vendor will help them better understand the energy consumption trends and behavior in residential sector?	Most likely, depending on their research budget
Q22	To what extent do you agree on disclosing your energy consumption information? Do any benefits affect your decision? Or other reasons?	I don’t think it affects me in the slightest, as long as the process does not require me to manually send in data.
Q23	Do you trust that your data won't be used for any other aims rather than analyzing the energy consumption behavior?	It will probably be used for advertising, but that can also be a good thing.
Q24	Do you think you can trust the energy providing companies and vendors with your data?	Yes
Q25	Why do you usually use a new technology? Is it because the majority are using it or you do your own research?	Do my own research before using any new technology
Q26	In general, to what extent do you think you are affected by what you hear from the people around you?	Moderately affected
Q27	In general, do you seek advice from friends before buying a new tech device, software or solution?	No

Q28	Do you think it is a cool thing to have an energy consumption house tracker that you can access from your phone or tablet?	Maybe
Q29	Finally, would you like to add anything to what you have answered?	

Q Code	Question	Participant 5
N/A	Date and Time	08/10/16 14:55
N/A	Initials	F.G.
N/A	Date	08/10/16
Q01	How old are you?	29
Q02	In which country are you living?	Sweden
Q03	Gender?	Male
Q04	Are you a fan of technology?	Yes
Q05	Do you own or rent your own household / apartment?	Yes
Q06	What's the area of your residence in square meters?	55.5
Q07	How many people are living in the resident? Please enter a number.	2
Q08	On average, how much do you pay every month on Energy Consumption including cooling and heating?	80
Q09	Do you have any kind of energy management or energy monitoring systems installed at your property?	No
Q10	Do you care for the environment or environmental issues? example: Global warming, Pollution etc...	Yes
Q11	Do you think that an increased energy consumption at households is bad for the environment?	Yes
Q12	Do you describe yourself as a person who is keen to keep his/her privacy?	A Little

Q13	Do you think that you would make use of an energy system that allows you to reduce your energy consumption?	Perhaps
Q14	Do you think it is a feasible idea to implement Residential EIS in households which can help you reduce your energy consumption?	If it works, is cheap and non-invasive
Q15	Is energy consumption an environmental problem?	yes
Q16	Do you find it easy to use an application on your mobile or tablet?	yes
Q17	Do you often need help or training using a new application?	No
Q18	Will you find it beneficial and interesting to control and monitor your major home appliances such as cooling, heating, lights, shutters, etc..) remotely? And why?	no, every system is vulnerable to hacking, they only thing that could be useful is a monitoring system so that you know if the stove is on or not.
Q19	If you would have an EIS implemented in your household, who would be using it?	Adults
Q20	Do you think that implementing an EIS, which gives you control to the house energy, can help in reducing your consumption?	No
Q21	Do you think that sharing your energy consumption data with the companies and vendor will help them better understand the energy consumption trends and behavior in residential sector?	Perhaps, but I would not want to do that for free
Q22	To what extent do you agree on disclosing your energy consumption information? Do any benefits affect your decision? Or other reasons?	I do not want to for personal safety reasons
Q23	Do you trust that your data won't be used for any other aims rather than analyzing the energy consumption behavior?	no
Q24	Do you think you can trust the energy providing companies and vendors with your data?	absolutely not
Q25	Why do you usually use a new technology? Is it because the majority are using it or you do your own research?	Do my own research before using any new technology

Q26	In general, to what extent do you think you are affected by what you hear from the people around you?	Very little affected
Q27	In general, do you seek advice from friends before buying a new tech device, software or solution?	No
Q28	Do you think it is a cool thing to have an energy consumption house tracker that you can access from your phone or tablet?	Yes
Q29	Finally, would you like to add anything to what you have answered?	The question above is phrased as: "is it cool", my answer to that is: Yes. However, if the question would be asked "Would you want" my answer would be: No.

Q Code	Question	Participant 5
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Q02	In which country are you living?	Sweden
Q03	Gender?	Male
Q04	Are you a fan of technology?	Yes
Q05	Do you own or rent your own household / apartment?	Yes
Q06	What's the area of your residence in square meters?	55.5
Q07	How many people are living in the resident? Please enter a number.	2
Q08	On average, how much do you pay every month on Energy Consumption including cooling and heating?	80
Q09	Do you have any kind of energy management or energy monitoring systems installed at your property?	No

Q10	Do you care for the environment or environmental issues? example: Global warming, Pollution etc...	Yes
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Appendix 4 – Shortcuts

Shortcut	Description
Exp	Questions for Experts
Q00	Questions for Residential Consumers
I00	Informant #
IS	Information Systems
EIS	Energy Information System
REIS	Residential Energy Information System
P00	Participant #
TAM	Technology Acceptance Model
UAT	User Acceptance Testing
ICT	Information and Communication Technology
GUI	Graphic User Interface

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